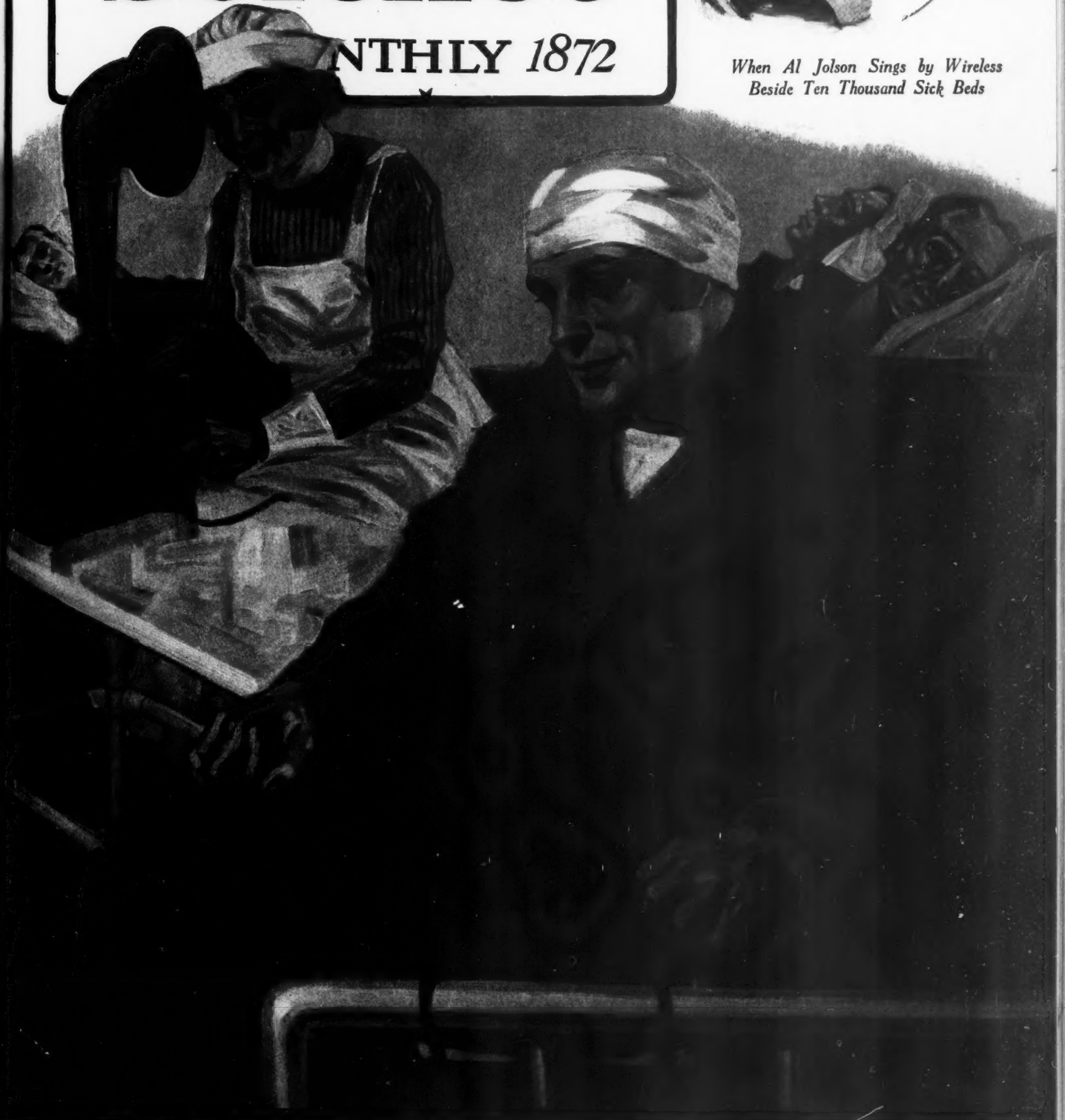
MAR 14 1922

Popular Science

MONTHLY 1872

When Al Jolson Sings by Wireless Beside Ten Thousand Sick Beds



What Daily Radio Concerts Can You Hear? (See Maps Page 72)

MARCH

300 Pictures of New Inventions

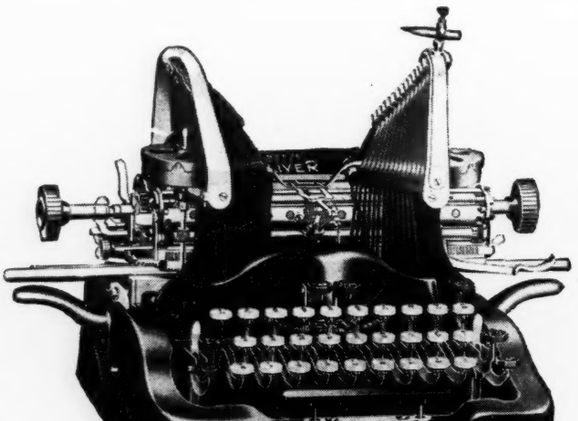
25 CENTS

Have You Learned to Typewrite Yet?

Universal typing is *here.* People are abandoning the slow, tiring task of long-hand writing. How long are *you* going to cling to it, in this world of advancement? Everybody dislikes to receive long-hand letters. And everyone shirks at correspondence when it has to be done the old-fashioned, tiring way. So join the progressive throng—get a typewriter NOW.

Free Trial

We ship the Oliver for five days' free trial. Let it sell itself. Or send it back.



14 Months To Pay

Pay for this Oliver while you use it. Only $4 per month and you soon own it.

$49.50 or $100? Which would you rather pay for a standard typewriter?

For 25 years all standard typewriters have been priced at $100 or over and still are—except the Oliver.

It is the only standard typewriter selling at half. It is the only standard, $100 typewriter being marketed direct from the factory.

Were it not for this simplified selling plan, the price of the Oliver would also be $100 or over. For it is the same fine machine, the finest model we have ever built. Over 900,000 have been sold.

We simply sell the identical $100 Oliver direct from the factory, and subtract all the extravagances of complicated selling. We have found that it is needless to maintain a high army of salesmen and agents. We have found it unnecessary to sustain a costly chain of branch offices in over 50 cities.

The $50.50 you save is the sum that it would cost us to sell the Oliver the roundabout way. Plus a saving made because of the volume of business created by our plan.

Send No Money

We let the Oliver sell itself. We ship it to you for free trial. Then you can compare it with other standard typewriters at $100 or over.

You become your own salesman. You are the sole judge. No anxious solicitor will urge you. In the privacy of your own office or home you can decide for or against the Oliver.

If you want to own it, send us $49.50 cash. Or if you wish to pay for it in installments, send us $3 after the trial period, then $4 per month until $55 is paid.

You can readily appreciate that it takes a super-typewriter to sell itself.

No test could be severer. Remember, there need be no fluent salesman to urge you.

If you decide against the Oliver, ship it back at our expense. We even refund the outgoing transportation charges, so that you do not risk one cent in the test.

Now we ask you, would you rather pay $50.50 additional and not get a finer typewriter? Would you care to support a $100 price for the Oliver, and get nothing tangible in return?

Or don't you agree that our new way of selling is logical? Doesn't it appeal to your common sense?

SAVE $50.50

How to Save

The coupon below brings you EITHER a Free Trial Oliver or Further Information. Check which yo desire.

This is all you have to do to s the $50.50. Without such a plan, yo have to pay $100 or over.

But this way you not only s you get the finest typewriter that can be built by a leading maker. It comes fresh from the factory, our late t and best model, a 25-year developme it.

Check the coupon *now* and mail in.

Canadian Price, $79

The OLIVER Typewriter Comp.
1103 Oliver Typewriter Bldg., Chicago, I

THE OLIVER TYPEWRITER COMPA ..
1103 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay $55 as follows: $3 at the end of trial period and then at th rate of $4 per month. The title to r main in you until fully paid for. If make cash settlement at end of trial period I am to deduct ten per cent an remit to you $49.50.

If I decide not to keep it, I will ship it back at your expense at the end of five days.

My shipping point is.....

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....

Street Address.....

City.....State.....

Occupation or Business.....

Some of the Famous Users:
New York Central Lines, Hart, Schaffner & Marx, U. S. Steel Corporation, N. Y. Edison Co., National Cloak & Suit Co., Morris & Co.—and hundreds of others.

Popular Science Monthly

March, 1922; Vol. 100, No. 3
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225 West Thirty-ninth Street

Wounded Veterans Discover New Joys in Wireless Music

Radio Outfit Now Becomes Hospital "Nurse"

By Armstrong Perry

DO you know what "ether" means to thousands of weary hospital patients these days?

It no longer suggests shock and the painful after effects of an operation. Rather, the word brings thoughts of pleasure, recreation, and amusement. For the radiophone has at last entered the hospital—where, above all places, it belongs—and musical entertainments, broadcasted daily through the ether from dozens of transmitting stations, are now being borne into hospital wards and orphan asylums, bringing comfort and delight to the lonely inmates.

Radio amateurs, in regions where broadcasts are thick, have long since found wireless a blessing in hours of illness. It is, indeed, a common practice now, around New York City, for the owner of a receiving set to liven up a sickroom—his own or a relative's—by hooking up his apparatus to the bed springs, which work wonderfully as an aerial. The patient, donning the head phones, can lie at ease by the hour, hearing the gossip and news of the great outside world, and catching in endless variety the lectures, sermons, songs, and instrumental music with which the great transmitting stations are now filling the ether.

From this use of radio in the sickroom at home to the installation of receiving sets in hospitals, has been an inevitable step. Equipped with a loud speaker, one reasonably priced receiving set can now entertain an entire ward, wiping out forever the gloom and hopelessness of hospital life.

Ask the boys in Ward 37, at Fox Hills Hospital, Staten Island, N. Y., for instance. They know! For the "godmothers" of the

A Blind Man's Vision

READ, on the next page, the letter addressed to you from a blind wireless amateur.

His words will open the eyes of many of us who have been blind to a great blessing which we might confer upon thousands of our afflicted fellows. The radiophone will bring untold comfort to the inmates of charitable institutions. Will you help organize a local campaign to install a set in a hospital?

© Keystone

SONGS FOR THE LONELY
From the radio broadcasting station, the voice of Anna Case, of the Metropolitan Opera, carried cheer through the ether to lonely hospital patients

FEW DULL MOMENTS HERE—Wounded veterans of the World War enliven their days in Ward 37, at Fox Hills Hospital, Staten Island, N. Y., with a new radiophone set to which they have fitted a paper horn as a makeshift amplifier

twenty-five wounded soldiers in this ward of the great government institution on Staten Island gave their "boys" a radio set last Christmas. Since that time, there are few dull moments in the ward.

The boys began by receiving an elaborate Christmas program from the Newark, N. J., station. At that time the loud speaker had not been delivered, but the inmates of the ward and their visitors passed the receiver from ear to ear, and improvised a paper horn that made the songs and messages audible to an attentive group. This new interest in life, and the keen pleasure that little clip onto his bed spring, picked up an instrument that resembled a telephone receiver, and heard the music of the distant phonograph as distinctly as though the machine were playing beside his bed. The electric currents were changed back, by the radio receiver, into sounds he could enjoy.

Hospital authorities who see in this an example worthy of imitation — and experience proves that it is—may be interested in a technical fact. The inventor of the system discovered that he could transmit voice and music within the area covered by the hospital without using high frequency currents such as are required in ordinary radio work. The radio waves from his apparatus travel through space at the rate of less than 10,000 waves a second. Passing through the magnets of the receiver, they cause vibrations of the diaphragm slowly enough to be heard as sound by the human ear. The bed spring is the "aerial." The body of the patient, quite unknown to him, serves as a "counterpoise," and makes it unnecessary to have a ground connection.

The particular system to be used is not important. One large hospital may broadcast its own entertainment throughout all the buildings. Another, like Fox Hills, may have an ordinary receiving set equipped with a loud speaker that permits a roomful of patients to "listen-in" on the regular broadcasts now blanketing the nation.

The latter is the simplest and most promising plan. And everybody who knows the ordinary gloominess of life in great institutions will realize how completely it will cheer the dreary life of the patients.

© U & U.

The hospital patient, today, can lie at ease and share by wireless in the world's doings

A Radio Letter from One Reader and a Broadcast Message to All

EDITOR OF POPULAR SCIENCE MONTHLY:

When I lost my eyesight, some months ago, I suddenly found myself deprived of the majority of pleasures that others enjoy. I realized then how dreary and lonely must be the lives of thousands of inmates of homes for the blind—and, indeed, of all institutions.

But to-day, despite my misfortune, I have a brilliant vision for the happiness of these people. A wireless telephone, installed a few weeks ago, has brought me again all the joys that mean most to mankind. I hear daily of the doings of the outside world. I get the news—national, international, political, every kind—even before people who are able to read it in their newspapers. I hear lectures, sermons, and concerts.

Hours of suffering are turned to ceaseless pleasure wherever a radiophone receiving set is at hand. Let me urge you to advocate the installation of receiving sets for the benefit of those confined to homes and charitable institutions.

ROSWELL PRESCOTT.
Newark, N. J.

POPULAR SCIENCE MONTHLY requires no urging in this cause. Founded fifty years ago by a famous blind scientist, E. L. Youmans, who contributed greatly to the development of science in America, the magazine feels a special sympathy for the blind. Moreover, POPULAR SCIENCE MONTHLY believes that few marvels of applied science in all the magazine's 50-year history have brought blessings to mankind exceeding the present promise of the wireless telephone.

We therefore raise the banner now for the extension of radiophone communication by popular demand to its maximum of utility.

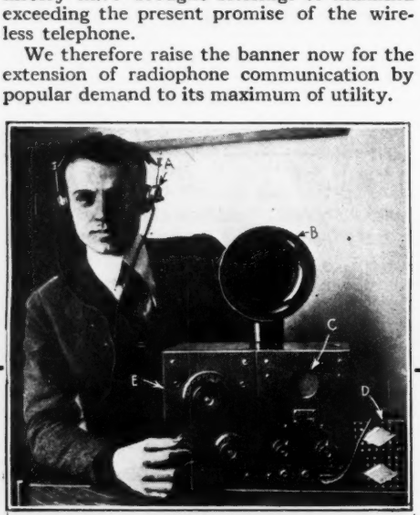
And we ask public spirited readers in every city to start a local campaign for the installation of wireless receiving sets with loud speakers, in deserving institutions.

Think what this will mean to the shut-ins in orphanages, in homes for the aged or the blind, and in hospitals. It means that the walls of the institutions are extended to the limits of the earth, as the listeners hear concerts from New York, opera from Chicago, press messages from all over the world, church services from Pittsburgh, news from the local paper, music from many broadcasting stations—more entertainment, more points of interest, one is tempted to say, than the average healthy person enjoys.

Many newspapers, like the Newark, N. J., *Call*, the Detroit *News*, the Seattle *Post-Intelligencer*, are already sending out wireless broadcasts. In every town a newspaper might go a step further and take up this campaign for radio in hospitals and asylums. Three hundred subscriptions of a dollar each would completely equip one hospital.

Which town will be first?

POPULAR SCIENCE MONTHLY stands behind the enterprise, ready to give all possible cooperation and information.



THIS typical radio receiving set, such as would serve for entertainments in hospitals and other institutions, costs less than $250 complete. It consists of head phones (*A*); loud speaker (*B*); audion (*C*); battery (*D*); tuner cabinet (*E*).

Here is an itemized statement of the cost of a typical set: short wave tuner, $65; detector and 2 stage amplifier, $65; 5 small "B" batteries, $6; 1 storage battery, $15; loud speaker, $45; head phones, $8; 3 vacuum tubes, $20; 1 plug adapter, $2. Total, $226.

With loud speaker and one stage of amplification, such a set will have a phonograph's range in any room. If conditions are favorable, the set should furnish daily recreation for hospital inmates.

In a white iron bed a soldier snapped a

NO matter where you live, the chances are that you can hear news and music by wireless. See on pages 72 and 73 the first radio charts of the United States ever published.

How Heroic Young Mechanic Saved Crew of S-48 from Death

AFTER a grim battle for life 60 feet below the ocean surface, 40 men, near suffocation from deadly chlorine gas fumes, were rescued recently from the submerged submarine S-48 off the Connecticut coast, through the heroism of a 19-year-old mechanic.

At the moment when a 12-hour struggle against rising water and poison gas seemed doomed to failure, Peter F. Dunne, of Bridgeport, Conn., wriggled his way through a torpedo tube 18 inches in diameter, and by means of a rope that he dragged with him, made it possible for his comrades to climb to safety.

Seas Flood Compartments

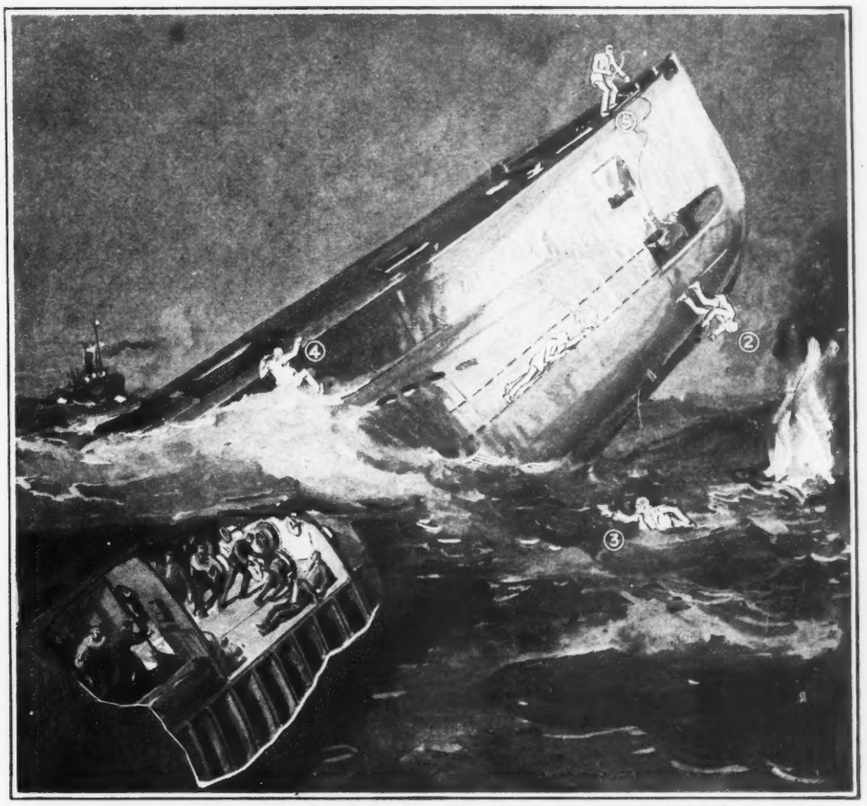
The accident occurred when the S-48 was on her trial trip. Everything went well until she submerged a few hundred yards from the shore. Then, through an open manhole, the seas suddenly poured and flooded the two after compartments. Seeping into the storage batteries, the salt water liberated clouds of chlorine.

Facing almost certain suffocation, the crew worked desperately. They bailed with everything available, even with coffee cups, until they succeeded in preventing the gas from increasing. Then, by discharging oil and dropping tons of pig iron ballast, piece by piece, through a sounding tube, they lightened the ship until the bow gradually rose above water.

How to summon aid was the next problem. Young Dunne volunteered to crawl through the long torpedo tube! This steel tube was scarcely wide enough to admit a man's shoulders. And to make the trip more perilous, its polished length slanted steeply upward.

Yet with the odds all against him, Dunne went ahead. Removing his clothing, he wormed his way slowly and painfully to the outside of the hull, dragging with him a rope that was to aid the rest of the crew in making the passage—only to discover that the smooth sides of the submarine offered no projection to which he could attach the rope. But above him on the bow he observed a cleat.

Quickly he dove into the icy waters and fought his way through the heavy seas to a point where he could climb to the deck. After fastening his line to the cleat, he returned to the inside of the ship, where he fainted from cold and exposure. But by means of the rope which he had fastened, the other men of the crew escaped from the gas-filled hull through the tube and lighted flares as a signal to the ship that rescued them.



The perilous journey of 19-year-old Peter F. Dunne to rescue 40 men trapped in the sunken submarine S-48 is described by the small white figures in the illustration.

Dragging a rope with him, Dunne struggled through the narrow torpedo tube (1), dove from the tube opening at the bow (2), fought his way through heavy seas (3), and climbing to the deck (4), finally succeeded in attaching a rope to a cleat (5), thus aiding his comrades to crawl through the tube and signal for aid

Whirling Wheel on Ballroom Wall Awards Prizes to Dancers

TO add zest to dancing by mixing orchestra music with a game of chance, a roulette wheel is now being used in a London club as a distributer of dance prizes. A large dial and pointer on the wall of the ballroom supplies novel amusement for the dancers.

Toward the end of a number, the orchestra leader throws a switch that starts the pointer spinning. The music suddenly stops—a signal for the dancers to halt wherever they may be and wait for the hand to come to rest at some number on the dial.

The dance floor is marked in numbered sections, and the couple standing on, or nearest to the number at which the pointer stops, receives a prize. The game is purely one of luck, but as the wheel begins to spin, the dancers maneuver to reach what they believe will be the winning number.

The orchestra music ceases as a signal for the dancers to halt and when the spinning hand stops at a number on the dial, the couple standing nearest the corresponding number on the ballroom floor wins the prize

DO your shoes pinch your pocketbook? Read, on pages 56 and 57, how science is improving methods of tanning and so reducing America's annual billion dollar shoe bill.

Above is the redwood starting its journey. By tautening and slackening guy ropes, a donkey engine moved the tree slowly along on skids

Giant Redwood Moved without Felling

PERFORMING a feat said to be without parallel in the logging industry, lumbermen of Freshwater, Calif., recently moved a giant redwood tree, 210 feet high and weighing 315 tons, a distance of 20 feet without lowering it from the vertical position.

The loggers wished to use the tree as a lead pole for pulling in large logs and loading them onto flatcars at the terminus of the logging road; but it stood 20 feet from the right of way, and to move the tracks was not practicable. Felling the tree and then raising it again seemed a waste of effort, so the men determined to move the giant without lowering it.

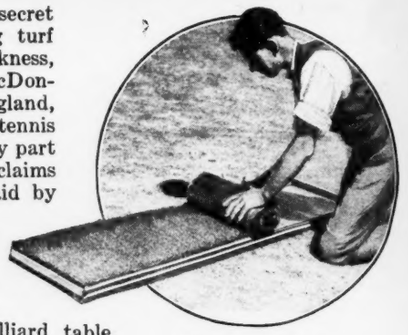
First they guyed the trunk of the tree with six 1¼-inch cables, then sawed it halfway through on one side, and blasted the half stump away below the cut. Skids were placed under the edge of the butt, the rear guys were slacked two feet, the front guys drawn taut, and the tree sawed clear through.

Then, by a process of tautening and slackening the guy lines, a powerful donkey engine moved the tree two feet at a time along the skids to the desired position.

At its destination, the tree, firmly "planted," served as a lead pole for pulling and loading logs at the terminus of the logging road

Tennis Courts Shipped by Crate

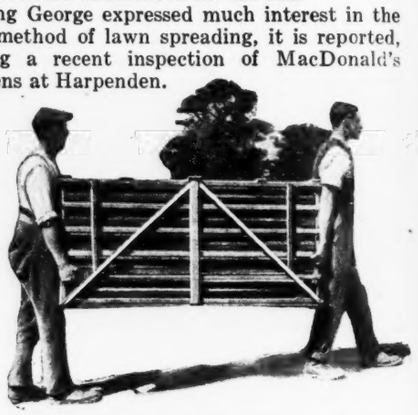
THANKS to a secret method of growing turf in strips of uniform thickness, a gardener named MacDonald, of Herpenden, England, is enabled to ship lawn tennis courts in crates to every part of the country. He claims that a tennis court laid by him in the afternoon, will be firm enough to play upon by the next morning, and will be as level as the proverbial billiard table.



Cut in strips of uniform thickness the turf is laid in shallow trays for shipment

For shipment, the turf is cut into strips and packed on shallow trays. From eight to a dozen of these trays of fresh, green turf are nailed into a crate and sent to their destination by express. This method prevents damage to the turf during transit, and facilitates relaying the sod. In making the tennis court, a perfectly flat surface, of course, must be prepared as a foundation for the sod.

King George expressed much interest in the new method of lawn spreading, it is reported, during a recent inspection of MacDonald's gardens at Harpenden.



This section of a lawn tennis court, like other sections, travels by express in trays snugly packed in a shipping crate

The Farmer Can Now Read Tractor's Pull as He Rides

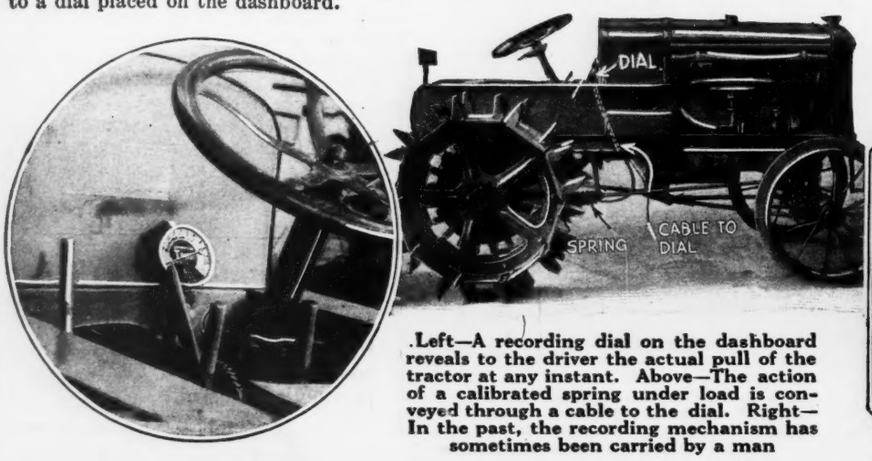
TO safeguard against an overloaded engine and to lessen the risk that some light tractors run of rearing up and turning over, a dynamometer of recent invention registers on a dial the pull of the farmer's tractor just as the speedometer records the velocity of a pleasure car.

The device consists essentially of a calibrated spring inserted between the load and the drawbar of the tractor. The action of the spring under load is conveyed directly to a dial placed on the dashboard.

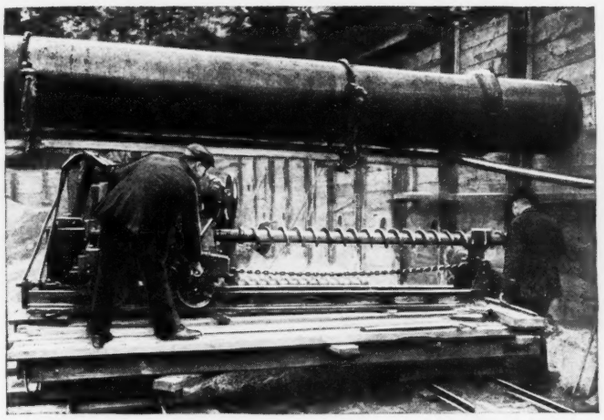
The dial is supplied with a circular card, revolving by clockwork, that makes a permanent record of the pull of the tractor throughout the day. Thus if a farmer has a fleet of tractors of the same kind doing the same work, it is a simple matter to compare the records and find out what is the best fuel mixture or manner of operation. The effective horsepower can likewise be determined. While the device is continuous in operation, it will reveal as readily the amount of pull at any particular instant.

The calibrated spring is strong enough to withstand the rough usage to which it is subjected, and is enclosed in a water and dust proof case. The cable connecting the two parts of the apparatus resembles the regular speedometer cable in outward appearance, but is adapted to the transmission of the reciprocating movements of the spring rather than the revolutions of a wheel.

In some states the dynamometer is used in testing the pulling power of tractors before they are sold, as a protection to the prospective purchaser.



Left—A recording dial on the dashboard reveals to the driver the actual pull of the tractor at any instant. Above—The action of a calibrated spring under load is conveyed through a cable to the dial. Right—In the past, the recording mechanism has sometimes been carried by a man

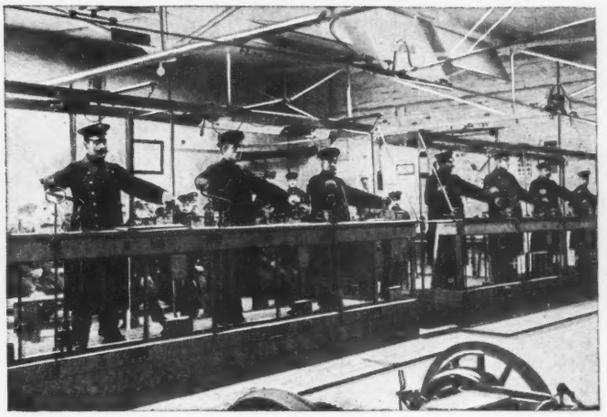


Giant Trench Drill Digs Subways Now

GIANT boring machines, designed and completed in Germany before the end of the war, and intended for purely military uses, are now being employed in contracting operations by the builders of Berlin's new subways, now in course of construction.

The machine seems to have been intended for building mines and countermines in "No Man's Land," or for constructing the huge underground dugouts for which the German engineers were famous; but in peacetime it appears to be as well adapted to boring pipe lines in concrete foundations.

Power is derived from an electric motor. A winch that winds in a chain hanging under the borer keeps a constant pressure on the bit. The operator controls the rate of feed by a hand wheel regulating the speed of the powerful winch.



Dummy Cars Test Berlin Motormen

PSYCHOLOGICAL tests are employed to select the motormen of Berlin. Before the men are entrusted with cars, they must prove that their visual and muscular reactions are quicker than those of the normal man. Standing on practice platforms resembling the platform of a car, the candidates undergo rigid examinations.

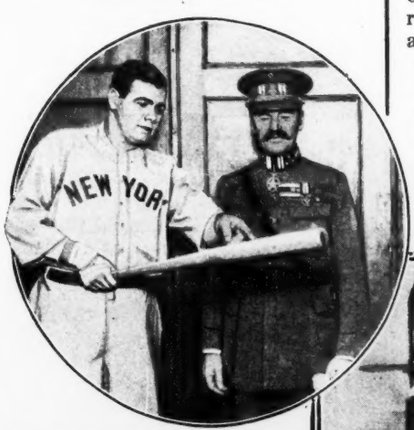
Every conceivable emergency is reproduced, such as breakage, electric shocks, and accidents. The actions of the novices in meeting such emergencies and the time it takes them to respond are carefully recorded.

The tests have revealed that the men vary greatly in the interval elapsing between visual stimulus and muscular response. Obviously the quicker man is the better motorman, and through these tests, the Berlin company has effected a marked lowering in operating costs.

Your Credit at a Glance

DO you know just what happens when you "charge" a purchase in a large department store? You see the sales clerk write your name and address, with the amount of the purchase, on a charge slip, then pack the slip into a cylindrical box and start it on its way through a pneumatic tube to some unknown destination. A minute later the slip returns by the same route, approved or otherwise, to the sales clerk.

What happens in the interval? If you look behind the scenes in the credit department of the store, you will see long rows of revolving card index files. Each file contains hundreds of names of customers, with an exact, up-to-the-minute record of each customer's credit. Somewhere among the thousands of names is yours; yet the system of indexing has been so perfected that it takes only a moment for a clerk to locate your name, verify the fact that you have a charge account and determine whether your credit is good for the amount of your purchase. If you have lagged in the payment of your bills, that fact is so recorded that the clerk can read the story at a glance.



Belgian General Learns to Bat

GENERAL JACQUES, of the Belgian army, received a lesson in batting from an expert during his stay in America, when Babe Ruth showed the famous soldier how to "line 'em out." The Babe demonstrated where to meet the ball, how to stand at the plate, and how to swing.

The general proved to be an apt pupil for a man who had never had his hands on a baseball, and is said to have knocked out a couple of creditable hits. His lessons in batting, however, were not extensive enough to put him in the home run class.

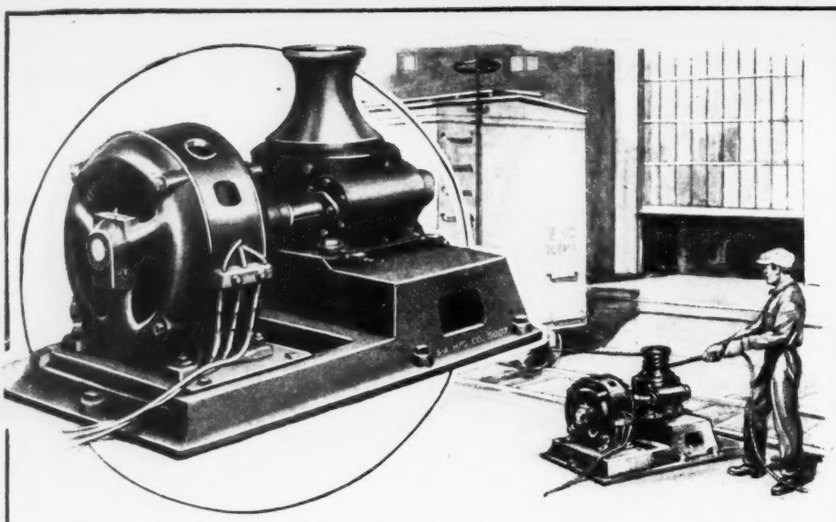
Terminals of the pneumatic tubes through which charge slips travel from store counter to credit department are seen in rear of the revolving files

© Ewing Galloway

Water Beats Drum and Hogs Run

WILD hogs are frightened away from the rice fields of Ceylon by a simple yet ingenious device of native invention, consisting of a large piece of hollow bamboo pivoted between two forked sticks, and placed where it will be filled by a small stream of water. A plug or cork is inside the bamboo just below the axis.

The upper end, when it fills with water, tips forward, the water spills out, and the bamboo falls back. In so doing, its lower end strikes a large stone, producing a hollow, booming noise that is said to terrify the hogs.



Winch is Now "Strong Arm" on Factory Siding

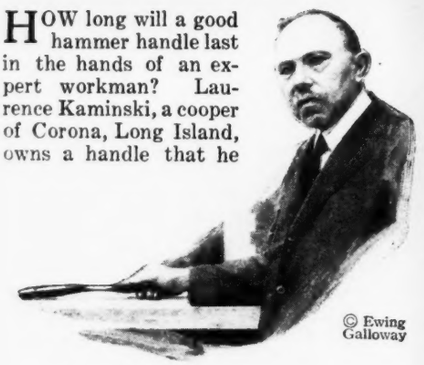
WINCHES operated by electric motors, placed near the railroad tracks on factory sidings, are doing away with the antiquated "strong arm" or manual methods of moving freight-cars. By expediting the switching, they reduce freight-handling charges.

Only seven and one half horsepower is consumed when the machine is used. The gearing of the winch is so designed that this force will put a 4000-pound pull on the rope, and give a rope speed of 37 feet a minute.

A capstan of the vertical type adapts the machine for all-round service. This capstan, turned by a worm-gear operating in oil, is self-locking, a feature especially desirable where it is necessary to snub the rope in order to hold the load on down grades.

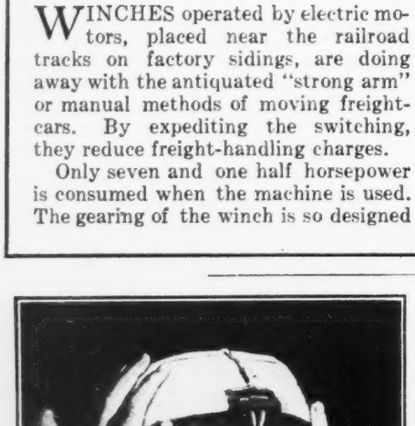
Deep Hollows Worn in Old Hammer Handle

HOW long will a good hammer handle last in the hands of an expert workman? Laurence Kaminski, a cooper of Corona, Long Island, owns a handle that he says has been in daily use for 25 years. In addition, the handle serves as conclusive evidence that the much-debated question, "Do hammer-handles wear?" must be answered in the affirmative.



At the grip, deep hollows have been worn solely by the friction of the hand; nearly a quarter of an inch of wood has been worn away from each side. The core that remains is smooth and highly polished.

It is remarkable testimony to the workman's skill that a shaft scarcely an inch wide and less than half an inch thick should not have been broken.



At Last Outdoor Sleepers Can Keep Heads Warm

OUTDOOR sleeping is likely to be more popular with the use of a newly designed electrically heated pad to keep the scalp warm; for—particularly in the damp air and changing temperatures of spring—it is sometimes difficult to sleep comfortably without putting the head under the bedclothes. This, of course, defeats the purpose of sleeping outdoors.

To fill this need, the new electric pad is shaped for the head and designed so that the temperature never rises enough to injure the hair. The connection cord is attached to any electric-light socket.

Printed Page Is Negative under Flashlight

WHERE details from a line drawing are wanted in a hurry, and it is impossible to take a book containing the drawing from the library or to photograph the page, it is claimed that a rough, emergency reproduction can be made with a flashlight and a piece of sensitized photographic print paper. The print paper is slipped under the page to be copied, with the sensitized side against the drawing. Then, by passing a flashlight slowly over the paper about a dozen times, an image is made that can be developed later.

The same results may be obtained when the print paper is placed above the illustration. This method is required where

printing or another drawing happens to be on the back of the paper. The printed page acts as a negative, since the paper will reflect light to a limited extent while the black ink absorbs the feeble rays altogether. As the page and the sensitized paper are face to face in the second case, the copy obtained will be reversed.

Auto on Railroad Tracks Hunts Forest Fires

MOTOR-CARS with flanged wheels are now rivaling airplanes as a means of fire patrol in Western national forests. These cars make regular runs over the railroad tracks leading through the forest, scouting for blazes started by sparks thrown from locomotives. The auto also serves to bring the fire-fighting crews quickly to a spot where a fire is discovered.

Inventors are at work to improve the car, which at present has a tendency to jump the track. The solution of this problem will probably mean an increased use of the flivver by fire-fighters. The "smoke-chasers" extinguished 51 per cent of the 6078 forest fires reported last year before any of them had burned more than one quarter of an acre of forest.

Buttons for Germ Food

BUTTON shavings are the latest source of chemical sugar used in feeding disease germs in the laboratory. Chips from the ivory nut, a product of the wilds of Ecuador, left after making buttons, are treated by an involved process that results in a syrup. This syrup is evaporated and a few grains of white sugar of remarkable qualities are obtained. The sugar is employed also to detect the presence of certain contagious diseases.

How Costly Is Your Car?

DO you pay a small fortune each month for fuel, tires, and repairs? Read, on pages 74 and 75, the prize-winning letters in the contest, "How I Keep Down Car Expenses," and discover how other POPULAR SCIENCE MONTHLY readers hammer down the upkeep of their automobiles.

Does Newly Found Ape Man's Skull Weld New Link in Our Ancestry?

Gorilla-Faced Caveman Had Brain Like Ours

"THE missing link in the chain of human evolution will be discovered some day," declared an eminent British scientist in 1912, "in the form of a creature with the brain, voice, and erect stature of modern man—and the brutal face, flat nosed and heavily ridged above the eyes, of a bull ape." In other words, he predicted, it will be found that man attained his upright posture and full intellectual powers long before he lost facial resemblance to his simian forebears.

Prophesy Is Fulfilled

The discovery thus foreseen a decade ago is now a fact.

At the end of a long, tunnel-like cave, 90 feet below ground level on the mining claim of the Rhodesia Broken Hill Development Company, in northwest Rhodesia, South Africa, native diggers recently uncovered a jawless skull and several large bones of what scientists believe to be a prehistoric ape man that lived at least 50,000 years ago.

The cave in which the mysterious skull lay has become famous, since its discovery several years ago, as the Broken Hill "Bone Cave." Its walls and roof are encrusted with glittering masses of crystals and stalactites, while the floor is formed to a depth varying from four to twelve feet, of the partly fossilized animal skeletons which must total hundreds of tons in weight. Only in one part of the cave, where the walls and the ceiling have been destroyed by the action of water, is the mass of bones cemented together. Elsewhere the bones form a vast and indescribable jumble composed of the remains of large and small mammals, birds, and reptiles.

Found in Huge Bone Pile

The floor at the end of the tunnel was found to be deeply covered with tons of these remains; and in this great bone pile, one of the diggers found the strange skull, almost perfect, which he took for that of a large ape.

The find was sent at once to the office of the mine owners. Later it was possible to recover a large bone of the leg, one of the collar-bones, part of a shoulder blade, portions of the pelvis, and several other fragments not yet identified.

An examination of the part of the cave in which the skull and other bones were found, disclosed evidence that adds a powerfully dramatic element to the discovery. Near where the human skeleton rested, the crushed skull of a large animal, presumably a lion, was found, also a large stone.

The combination suggests how man and

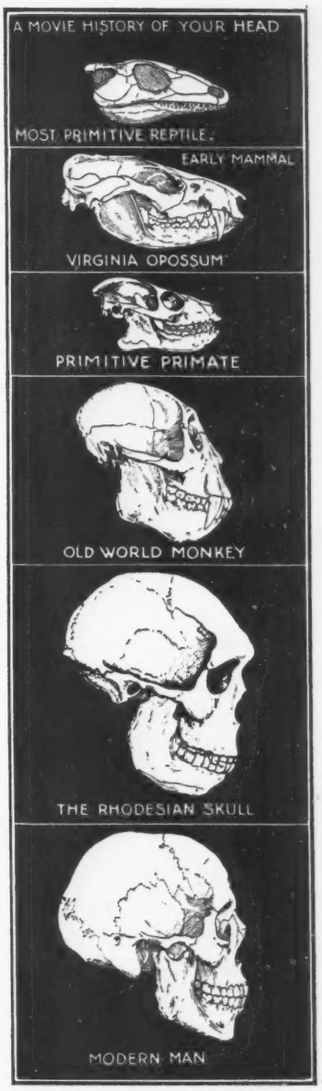
Where Do We Go from Here?

DISCOVERY of a new link in human history—the mysterious ape man of South Africa—stirs up again the unsolved problem of how we really evolved from a pre-monkey type of animal. More than that, it makes us wonder toward what we are evolving now.

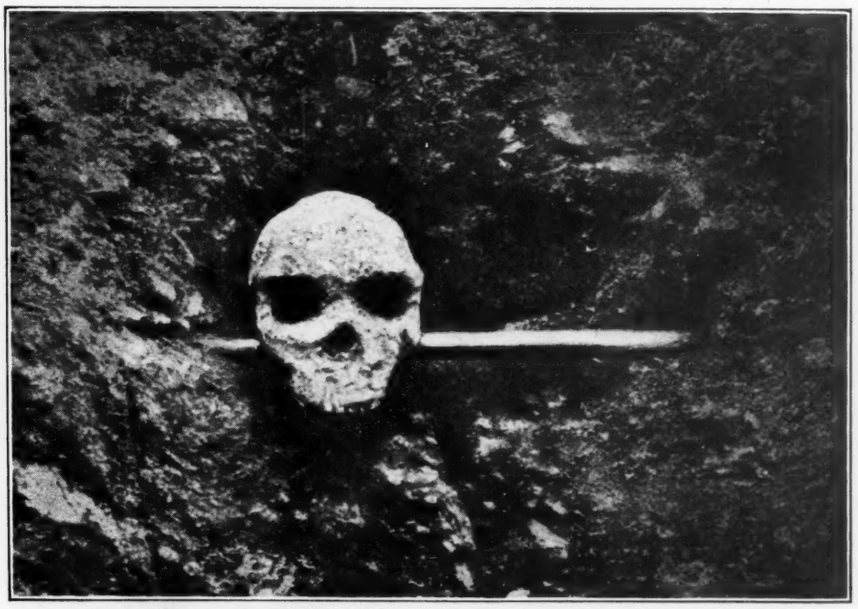
Some scientists deny that any change in man's appearance is discernible. But others declare that existing tendencies may make our children's more remote descendants look like the smallest man pictured here. Man may grow noticeably shorter and darker, with smaller jaws, slighter bones, stronger forearm and larger big toe, losing the little toe and the back molars.

Some noted eugenists, believing it possible to breed a physical superman within a few generations, declare now that unless we evolve consciously toward such a glorified race, the human species runs the risk of being completely wiped out like other species before it.

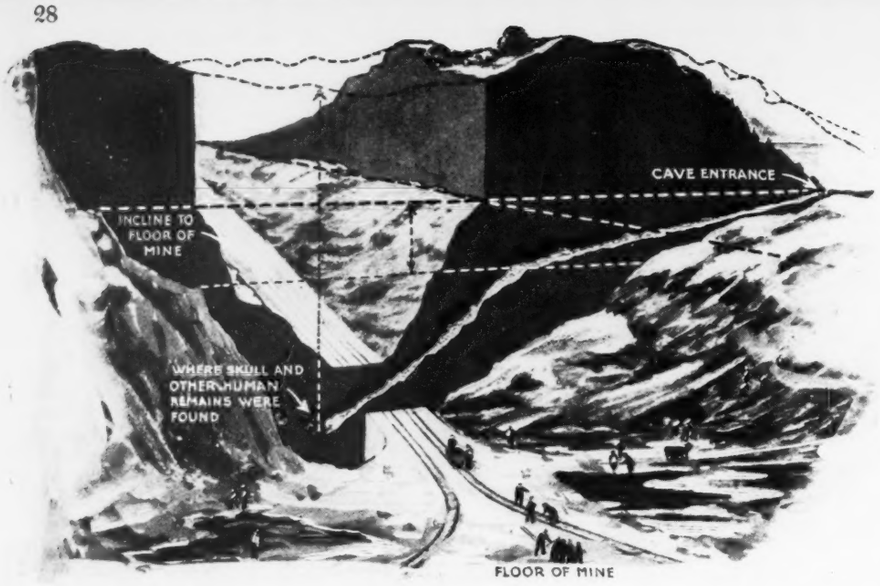
Note, by the way, tnat science has yet to find any real trace of a "missing link" between man and lower animals.



What story will the next reel tell? A stirring drama of the ages is unfolded in this chronicle of the evolutionary changes in the form of the head from the elongated, flat reptilian skull with small brain capacity, through the animal types, to the head of modern man



Deep down in the Broken Hill mine in Rhodesia, South Africa, the skull of the ape man was discovered. The photograph above shows the skull, in its original position, where it had been for perhaps 50,000 years



In this cut-away view of the Broken Hill mine excavation may be seen the long, tunnel-like "Bone Cave," at the bottom of which the Rhodesian skull was discovered. The spot where the skull lay is about 60 feet below water level, 90 feet below ground level, and 140 feet below the original hilltop

lion came to their death. Armed only with a large boulder, this primitive man must have fought a terrific battle against overwhelming odds in the darkness of that African cave many thousand years ago. Both he and the lion succumbed in the struggle and their bodies rested for ages side by side where they had fallen, mute witnesses of the tragedy enacted in the dim past.

The presence of hundreds of tons of animal bones in this African cave presents an interesting problem. Of the origin of the tunnel-like cave the geological formation of the locality offers no explanation.

Some geologists believe that the cave is not a work of nature, but was dug out of the comparatively soft rock by prehistoric men many thousand years ago, either for mining purposes or to provide a shelter and protection from the wild animals abounding in that part of Africa at the time.

As the age of the human skull found in the cave is estimated to be at least 50,000 years old, and it is highly improbable that man at that period was sufficiently advanced for even the most primitive method of mining, this theory of the origin of the cave seems untenable. The theory becomes more rational, however, if the opinion of Marcellin Boule and a few other paleontologists is accepted. They contend that the Rhodesian skull belongs to a much more recent period and probably represents a negroid type which still persists in Africa.

Evidence of Evolution

Ever since Darwin and other scientists of his period laid the foundation for the theory of evolution, believers in this theory have hoped for conclusive evidence confirming it. The first important find, a skull unearthed at Gibraltar in 1848, greatly stimulated their hope; and when, in 1856, an incomplete skull was found in the Neander valley near Düsseldorf, Germany, these scientists concluded that the so-called Neanderthal man represented an early type in the evolution of man. By comparison it was found that the Gibraltar skull greatly resembled the Neanderthal skull and presumably belonged to the same period.

Two nearly complete skeletons representing the same type were found at Spy, near Dinant, Belgium, in 1887, and since then many other skulls and more or less complete skeletons of that type have been unearthed in different parts of France, Croatia, Moravia, and on the island of Jersey in the English Channel. The Neanderthal race is believed to have lived throughout Europe 25,000 to 100,000 years ago.

In 1891 Eugene Dubois found parts of a skull and skeleton near Trinil, a village in central Java. They were the remains of an extremely primitive type of man, so near in the stage of evolution to the anthropoid apes, that some scientists were at first inclined to doubt the kinship between *Pithecanthropus erectus*, as the Java man is called, and modern man. These remains were found in deposits regarded as contemporary with those made during the first glacial period of Europe, about 475,000 years ago.

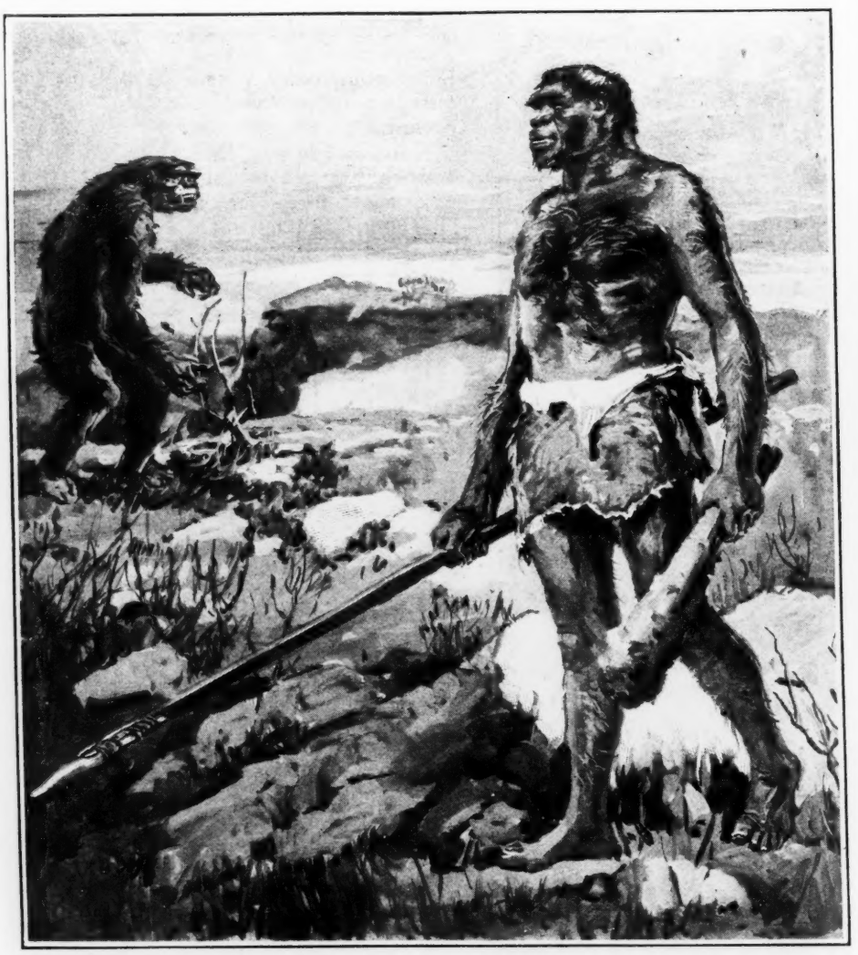
Grimaldians Nearer Apes

In 1906 the skeletons of a youth and a woman, representing a negroid race, were found in a grotto near Mentone, France. After the name of the grotto, the race to which the owners of the skeletons belonged was called the Grimaldi race. In the structure of their teeth the Grimaldians show a greater resemblance to the anthropoid apes than the Neanderthal race.

In the following year, 1907, the remains of the Heidelberg man were discovered. These represent a much earlier type than the Neanderthal man. The race to which the man belonged presumably lived about 200,000 to 350,000 years ago.

In 1912 the remains of the third oldest of the known human types were found in the Thames Valley near Piltdown, Sussex, England. It is believed that the race which the skull represents existed between 100,000 and 150,000 years ago.

Between 1852 and the present day skulls and entire skeletons of another widely spread prehistoric human race have been found in France, Spain, Austria, Wales, and Syria. The race, which is of more



That our caveman ancestor attained erect gait and a brain equal to our own before his face was refined from the ape-like is a theory apparently substantiated by this reconstruction of the Rhodesian man, facing the gorilla he still resembled

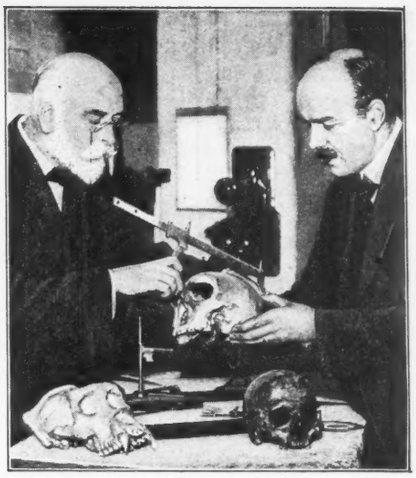
recent date than the Neanderthal race and probably supplanted it in Europe, was named the Cro-Magnon race. It is believed that the Cro-Magnons came from Asia, where certain of their racial characteristics still survive. They belonged to the later paleolithic age and showed a remarkably high development.

In this way, by repeated discoveries, scientists have started to write their record of man's evolution from the beast. But many pages, even chapters, of this long history are still a blank. On what page shall science inscribe its description of the man of Rhodesia?

Brain Case Typically Human

For while the Rhodesian skull exhibits a marked general resemblance to the Neanderthal type, a number of differentiating features make it difficult to fix its age and relative evolutionary position. For example, despite the contrast between Neanderthal man's apelike slouch and Rhodesian man's erect posture, close study has revealed that the face of the man of Broken Hill is by far the more apelike of the two.

Excellently preserved and showing no trace of mineralization, the Rhodesian skull is typically human in the thickness of the brain case. The brain capacity has not yet been measured exactly, but it is clearly above the lower human limit. Yet facial development is heavy and of decided simian character. The brow ridges are bulging and extend farther laterally than those of Neanderthal man. Clearly, too, the jaw must have been more massive even than that of the Heidelberg man.



Dr. A. Smith Woodward, eminent geologist (at left) measuring and studying the Rhodesian skull at the South Kensington Museum, London, England, where the skull is in his charge

The development of the dome of the Rhodesian skull presents many puzzling incongruities. Like the skull of the ape man of Java, it has a pronounced crista or ridge extending longitudinally, which indicates a very low type of evolutionary development. But in size and general contour the Rhodesian skull is much nearer to the modern type of man than that of the Neanderthal man. The race which the Rhodesian represents was evidently long headed. His skull has a maximum length of 210 millimeters, a width of 145 and a height of 131 millimeters. The opening in the base of the skull, through which the spinal cord passes, is located farther forward than in the skulls of the European representatives of the Neanderthal race, and it is this feature which indicates a perfectly erect posture of its owner.

Mouth Adapted to Speech

The roof of the mouth is well arched, and the palate of enormous size like that in some skulls of the European Neanderthal type. Thus the mouth was perfectly adapted to speech. The teeth are large, but entirely human. They are much worn and obviously met the teeth of the lower jaw edge to edge. The canines are not enlarged. The second molar is square, the third much reduced in size. All teeth were much affected by decay which also had spread to the tooth sockets.

If, despite the apelike features, the characteristics of the Rhodesian skull indicate that its owner belonged to a race more advanced than the Neanderthal man, the character of the limb bones found in the Broken Hill cave confirm this evidence with even greater conclusiveness. The tibia is long and slender, of a typically modern form, and might have belonged to a tall, fleet-footed man of the present time.

Judged by the clearly distinctive anatomical features of his skull and other remains, the Rhodesian man must be considered as the representative of a race different from any other prehistoric race known and must be assigned a place in the evolutionary scale somewhere between the Neanderthal type and the Cro-Magnons.

Thousand Tons of Rails Test Strength of Concrete Piers

A THOUSAND tons of steel rails were piled upon a concrete pier in Chicago recently, to determine whether piers extending only to a layer of hardpan, and designed for a four-story building, would support the weight of a 16-story structure on the site of the Chicago Union Station.

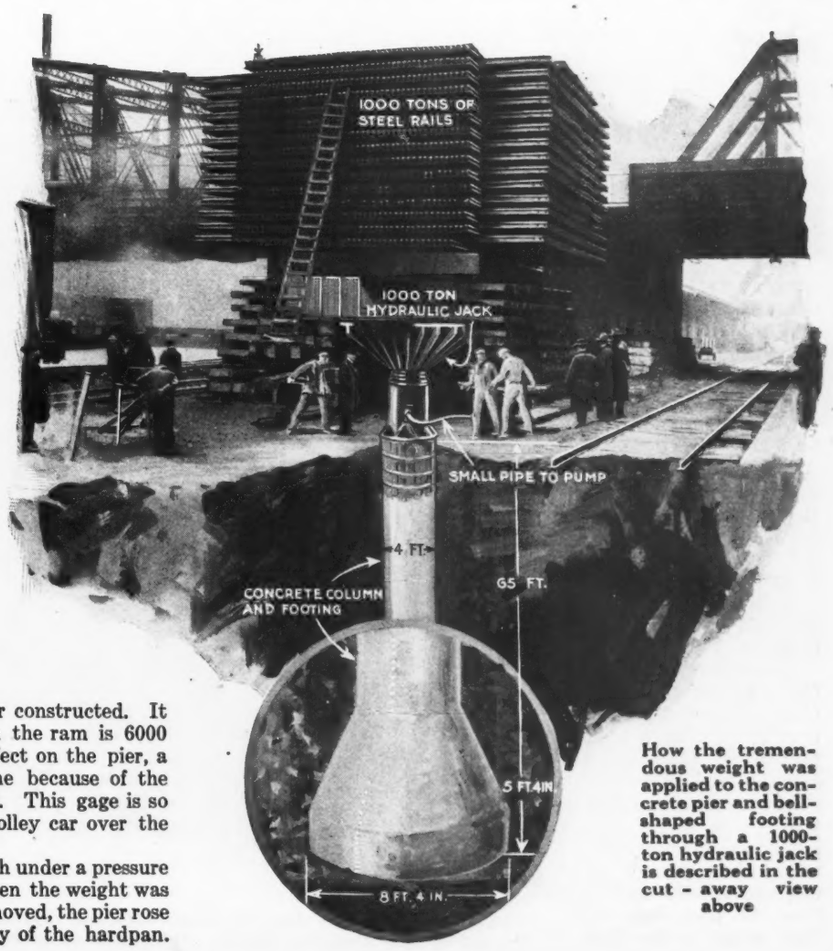
The soil at this point is composed of 65 feet of soft earth over an eight-foot layer of hardpan. Beneath the hardpan a second layer of soft clay and sand is encountered before rock is reached. The tests were conducted to avoid, if possible, the expense of excavating to bedrock, and to find how many additional piers would be required to support the 12 additional stories.

Tremendous Weight Applied

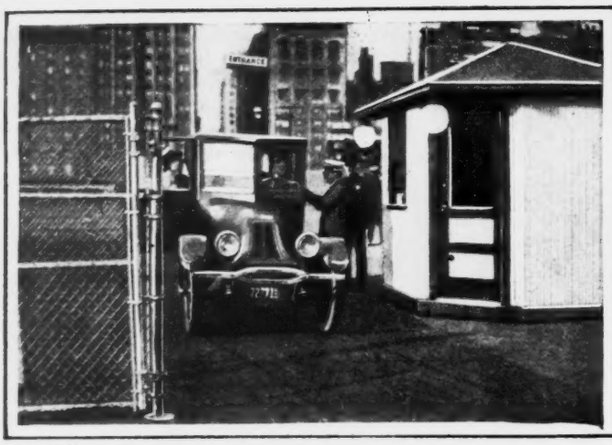
To conduct the test successfully it was necessary to apply a tremendous weight, and at the same time to install very sensitive measuring apparatus to register the exact distance the pier sank as the weight was piled upon it. The top of the concrete column was protected by a steel casting. On this was set a hydraulic jack, through which pressure could be applied. The rails served as a dead weight to bear the upward thrust of the jack, and did not rest upon the head of the pier.

The jack used is the largest of its type ever constructed. It will lift 1000 tons when the water pressure on the ram is 6000 pounds to the square inch. To register the effect on the pier, a special inclined draft level, filled with gasoline because of the cold, was set up directly on the concrete head. This gage is so sensitive that it registered the passing of a trolley car over the Adams Street bridge, fully 100 feet away.

The test revealed that the pier settled .18 inch under a pressure of 680 tons, and sank an additional .09 inch when the weight was increased to 1000 tons. When pressure was removed, the pier rose .26 inch. The settling, represents the elasticity of the hardpan.



How the tremendous weight was applied to the concrete pier and bell-shaped footing through a 1000-ton hydraulic jack is described in the cut - away view above



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REPUTED to be the oldest living thing in the world, a cypress tree standing in the churchyard of the little Mexican town of Santa Maria del Tule has the largest trunk of any known tree. The diameter of the trunk is 50 feet.

Twenty-eight people, with arms outstretched and finger tips just touching, can barely reach around the circumference. The diameter exceeds by 14 feet that of the largest of the California redwoods, according to Charles J. Chamberlain, of the University of Chicago. The height, however, is less than that of the sequoias.

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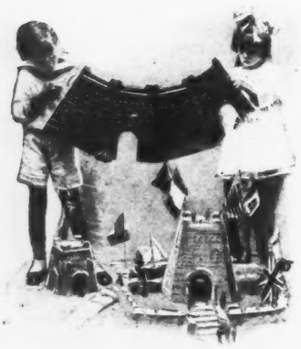
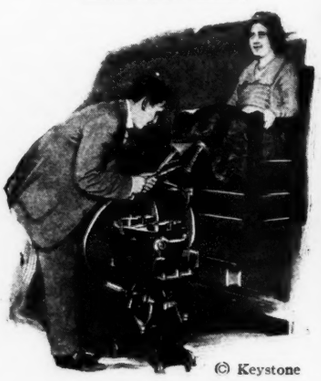




© Keystone

Sand Castles Made in Fancy Molds

KIDDIES on the seashore may make ornate and highly decorated sand castles by the use of a newly devised mold made from stamped tin, and constructed in four hinged sections.

It is locked together, and one corner held tightly while damp sand is packed in firmly from the top. Then the catch is undone, the mold is removed, and there stands a castle that will be the envy of the beach.

ONE reason milk is almost a perfect food is that it contains a high percentage of calcium salts. Calcium is the chief metallic element of the human body. An adult skeleton contains nearly four pounds of calcium, mostly in the form of phosphate of lime, which is the chief component of bone tissue.

Twenty-eight people, touching finger tips, can barely reach around the trunk of this Mexican cypress. It is believed to be more than 5000 years old

Electric Motor Is a Bootblack

AN electric motor transformed into a bootblack can polish shoes in less than a minute. The operator takes the polish from boxes on top of the machine and smears it on the shoes, then gives the preliminary polishing with a motor-driven brush.

To finish the job, an attachment consisting of four pieces of heavy felt is placed in an operating handle. As the felt pieces pass over the shoe, they produce a slapping, rubbing action similar to that of a polishing cloth in the hands of an expert bootblack.

The motor operates on any electric-lighting circuit. In the outfit is a box that holds all attachments for rubbing and brushing. An advantage, in addition to speed, is that only one application of paste is needed.

New Life-Line Pistol Has Long Range

GREATLY increased range in a line-throwing Very pistol has been attained in a new British model which will shoot life-lines hundreds of feet.

The desire of life-savers for a light, portable gun with the accuracy and range of the line-throwing cannon led to the adoption of the life-line rifle described in POPULAR SCIENCE MONTHLY for November. The new instrument is another step in the same direction. It is loaded with a bullet connected with a strong flexible wire, to which the life line is fastened.

When the pistol is fired, canvas prevents the flying life-line from cutting the hand

Wind Carves Strange Snow Shapes on Roofs During Storm in Swiss Village

HOW nature, combining snow, rain and wind, will sometimes turn sculptor, modeling strange shapes and designs, was strikingly demonstrated during a recent storm in the little Swiss village of Andermatt. After an unusual series of freezings and thaws, heavy masses of ice, elaborately carved by the wind, hung out like wide eaves from the roofs of houses.

A very heavy fall of damp, sticky snow was succeeded by a light rain and thaw. As the snow began to melt, a sudden stiff breeze sprang up that cut the soft surface into twisted and contorted shapes and froze the mass into thick blankets of ice, strong enough to support their own weight.

So much gasoline is carried up with the natural gas given off by an oil well in Alberta, Canada, that when the tap is removed the minute globules of gasoline form a bluish gray column projecting several inches above the mouth of the pipe.

Shrunken Body Is Two Feet Tall

PRESERVED better than many an Egyptian mummy, a shrunken body of an Indian chief who died more than 400 years ago has been brought to the United States by Jaun Kratiel, a Peruvian engineer. The mummy is only 25 inches high, for the body was shrunk and preserved by a secret "pickling" process known only to the South American Indians.

Tradition records that this is the mummy of Karruba, a Peruvian chief who led his tribe against the Spaniards in 1535. The beads worn by Señor Kratiel were found with the shrunken warrior.

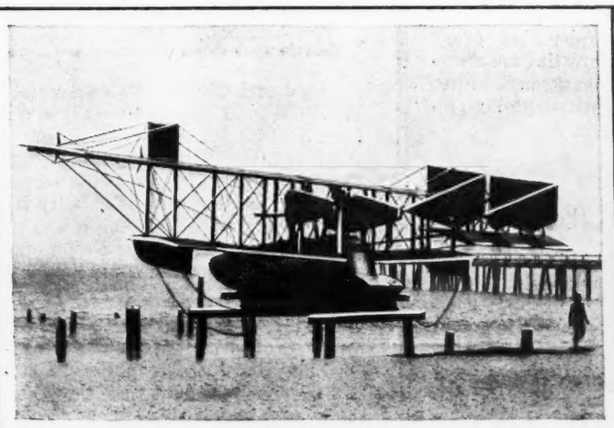
© Ewing Gallowav

The body of this Indian Chief was shrunk by a secret "pickling" process

Stranded Flying Boat Forecasts Future "Graveyards" for Worn-Out Air Liners

A BATTERED hydroplane, left on a Pacific Coast beach for the sea and wind to wreck, forecasts the day when airships no longer airworthy will be abandoned in aerial "boneyards" as ships are abandoned to-day. The sea has washed away the plane's launching platform, leaving it stranded high and dry with no slide from which to coast into the ocean. There it rests firmly in the sand while the tides come and go.

Unlike ships, planes have little salvage value once the engine and larger fittings are removed.

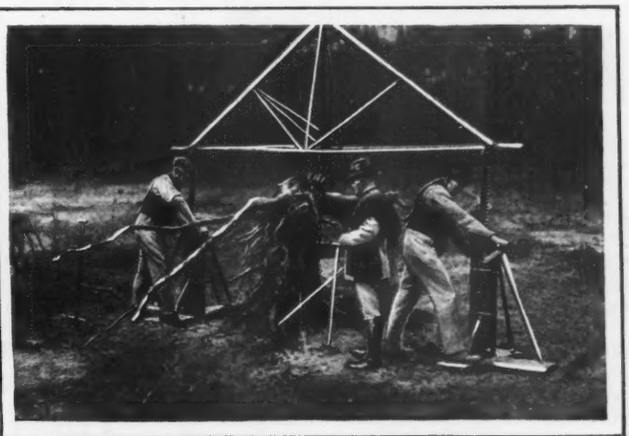


Will the outworn air liner of the future, like this hydroplane, find a last resting place on some remote beach?

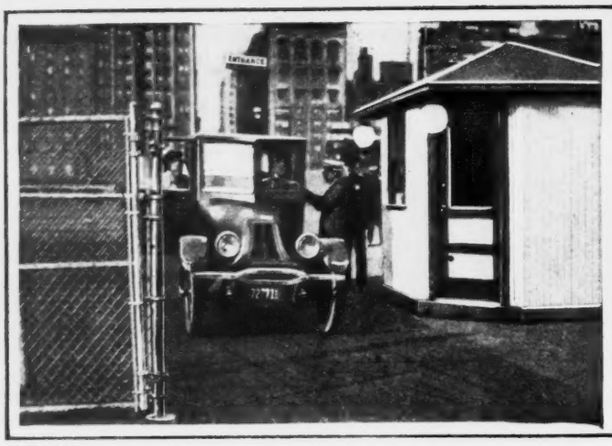
Heavy Jacks and Iron Pipe, Rigged as Stump Puller, Clear Land Quickly

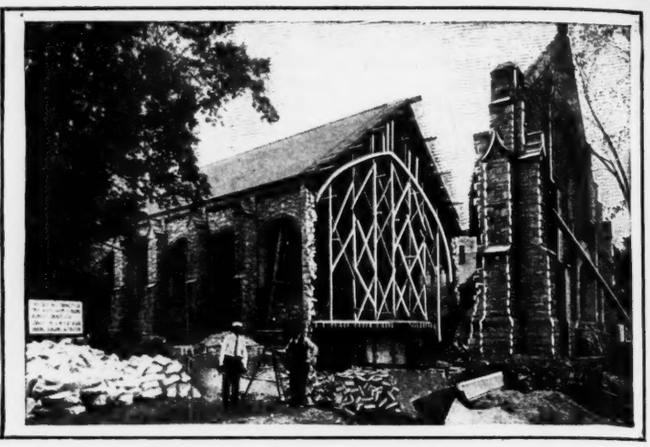
HEAVY truck jacks and a simple framework of iron pipe are clearing swampland in Germany at the rate of 30 stumps to each machine a day. The device is particularly well adapted for pulling stumps having a large root spread, and will work better in the moist, soft soil of a marshy area than in hard ground.

It has the merit of pulling out the roots as well as the stump, and so preparing the ground for plowing—all in one operation. The machine can handle stumps up to six inches in diameter. The pulling framework is raised by two hand-cranked jacks.



A simple iron-pipe framework to which the stump is attached is raised by heavy hand-operated jacks





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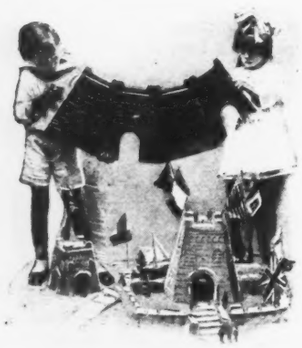
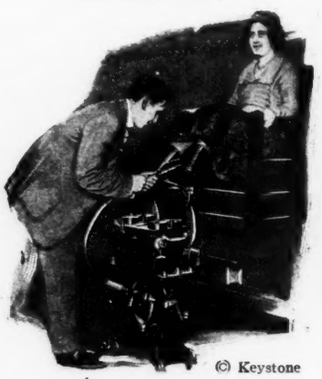
Judging from a similar cypress tree, five feet in diameter, which was found to have 200 year rings each foot of radius, Mr. Chamberlain estimates the age of the giant cypress at not less than 5000 years. The tree is still thriving, although it was probably of good size when men began to dig the foundations for the pyramids of Egypt.





© Keystone

Sand Castles Made in Fancy Molds

KIDDIES on the seashore may make ornate and highly decorated sand castles by the use of a newly devised mold made from stamped tin, and constructed in four hinged sections.

It is locked together, and one corner held tightly while damp sand is packed in firmly from the top. Then the catch is undone, the mold is removed, and there stands a castle that will be the envy of the beach.

ONE reason milk is almost a perfect food is that it contains a high percentage of calcium salts. Calcium is the chief metallic element of the human body. An adult skeleton contains nearly four pounds of calcium, mostly in the form of phosphate of lime, which is the chief component of bone tissue.

Twenty-eight people, touching finger tips, can barely reach around the trunk of this Mexican cypress. It is believed to be more than 5000 years old

Electric Motor Is a Bootblack

AN electric motor transformed into a bootblack can polish shoes in less than a minute. The operator takes the polish from boxes on top of the machine and smears it on the shoes, then gives the preliminary polishing with a motor-driven brush.

To finish the job, an attachment consisting of four pieces of heavy felt is placed in an operating handle. As the felt pieces pass over the shoe, they produce a slapping, rubbing action similar to that of a polishing cloth in the hands of an expert bootblack.

The motor operates on any electric-lighting circuit. In the outfit is a box that holds all attachments for rubbing and brushing. An advantage, in addition to speed, is that only one application of paste is needed.

New Life-Line Pistol Has Long Range

GREATLY increased range in a line-throwing Very pistol has been attained in a new British model which will shoot life-lines hundreds of feet.

The desire of life-savers for a light, portable gun with the accuracy and range of the line-throwing cannon led to the adoption of the life-line rifle described in POPULAR SCIENCE MONTHLY for November. The new instrument is another step in the same direction. It is loaded with a bullet connected with a strong flexible wire, to which the life line is fastened.

When the pistol is fired, canvas prevents the flying life-line from cutting the hand

Wind Carves Strange Snow Shapes on Roofs During Storm in Swiss Village

HOW nature, combining snow, rain and wind, will sometimes turn sculptor, modeling strange shapes and designs, was strikingly demonstrated during a recent storm in the little Swiss village of Andermatt. After an unusual series of freezings and thaws, heavy masses of ice, elaborately carved by the wind, hung out like wide eaves from the roofs of houses.

A very heavy fall of damp, sticky snow was succeeded by a light rain and thaw. As the snow began to melt, a sudden stiff breeze sprang up that cut the soft surface into twisted and contorted shapes and froze the mass into thick blankets of ice, strong enough to support their own weight.

So much gasoline is carried up with the natural gas given off by an oil well in Alberta, Canada, that when the tap is removed the minute globules of gasoline form a bluish gray column projecting several inches above the mouth of the pipe.

Shrunken Body Is Two Feet Tall

PRESERVED better than many an Egyptian mummy, a shrunken body of an Indian chief who died more than 400 years ago has been brought to the United States by Jaun Kratiel, a Peruvian engineer. The mummy is only 25 inches high, for the body was shrunk and preserved by a secret "pickling" process known only to the South American Indians.

Tradition records that this is the mummy of Karruba, a Peruvian chief who led his tribe against the Spaniards in 1535. The beads worn by Señor Kratiel were found with the shrunken warrior.

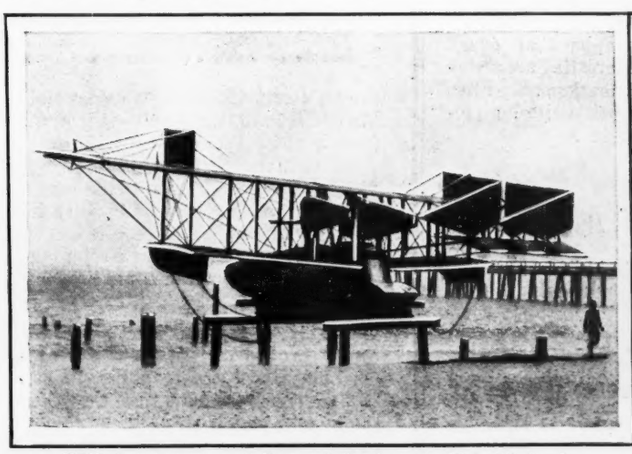
© Ewing Gallowav

The body of this Indian Chief was shrunk by a secret "pickling" process

Stranded Flying Boat Forecasts Future "Graveyards" for Worn-Out Air Liners

A BATTERED hydroplane, left on a Pacific Coast beach for the sea and wind to wreck, forecasts the day when airships no longer airworthy will be abandoned in aerial "boneyards" as ships are abandoned to-day. The sea has washed away the plane's launching platform, leaving it stranded high and dry with no slide from which to coast into the ocean. There it rests firmly in the sand while the tides come and go.

Unlike ships, planes have little salvage value once the engine and larger fittings are removed.

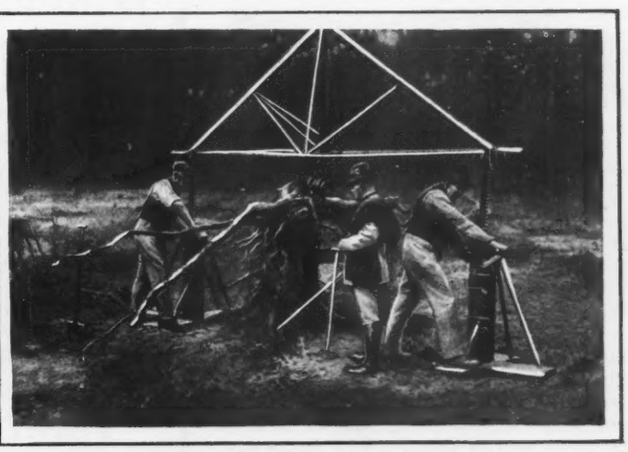


Will the outworn air liner of the future, like this hydroplane, find a last resting place on some remote beach?

Heavy Jacks and Iron Pipe, Rigged as Stump Puller, Clear Land Quickly

HEAVY truck jacks and a simple framework of iron pipe are clearing swampland in Germany at the rate of 30 stumps to each machine a day. The device is particularly well adapted for pulling stumps having a large root spread, and will work better in the moist, soft soil of a marshy area than in hard ground.

It has the merit of pulling out the roots as well as the stump, and so preparing the ground for plowing—all in one operation. The machine can handle stumps up to six inches in diameter. The pulling framework is raised by two hand-cranked jacks.



A simple iron-pipe framework to which the stump is attached is raised by heavy hand-operated jacks

Hiker Tramps into Jungles on Trip around World

AFTER tramping through South American jungles where he often was forced to travel from tree to tree above deep swamps, and to rely for food upon his skill with a bow and arrow, W. Kotal arrived recently on the Isthmus of Panama, completing the first quarter of his proposed walking trip around the world.

He started from Buenos Aires, Argentina, a year ago, and intends to walk northward to Alaska, then cross Siberia, Europe, and Africa. How long the trip will take, he does not venture to say.

Kotal often averages forty miles a day.

Flashlight Battery Screens Pictures Brightly

FLASHLIGHT batteries will furnish the illumination in a new magic lantern developed by two moving-picture men. By a new system of lenses and reflectors this comparatively feeble light will produce brilliant pictures seven feet in width, with excellent definition and detail.

The lantern is designed to use clips from motion-picture films instead of slides. Since the projection secured with the lantern is declared to be nearly equal to that obtained in theaters, millions of pictures taken on the Los Angeles "lots" in the past can be reproduced in the home.

Bicycle Tobogganing Is New Winter Sport

BICYCLE toboggans are adding new thrills to winter sports in Europe, where a strap-iron frame resembling a bicycle in shape, but equipped with broad iron runners instead of wheels, has made its appearance on the hills.

The runners are single, and in tandem, but as the front runner is attached to a set of handle-bars, the coaster can balance himself and steer just as he would upon a bicycle. Because friction between runners and snow has been reduced to the minimum, the new sled is speedier than older models. Even in soft snow, the front runner packs a path for the rear runner and makes considerable speed possible.

A skilful bicyclist can use this sled to "hitch behind" a wagon, attaching the tow-rope to the projecting loop in front of the handle-bars.

Guiding the runners with handle-bars, the coaster rides as on a bicycle

Load, and Aim at $500!

THE hunting season for photographs is open! Films are the ammunition. Every locality is a hunting-ground in this contest to win the $50 in cash prizes that POPULAR SCIENCE MONTHLY is offering each month for the best photographs of mechanical and scientific subjects.

Join the Hunt for Photographs

If you keep your eyes open, you will easily discover, somewhere in your community, a feat of engineering, a clever invention, or a new labor saving machine that will interest your fellow readers of POPULAR SCIENCE MONTHLY. Load your camera, include one or more human figures in the view, to give scale and human interest, and send the photographs to the Editor.

Or, at your workbench you have created some convenience for house, garage, or garden. Photographs of such subjects are equally eligible if a human figure is included in the view.

You Can Bag the Winning Picture

Already, photographs that every reader will find interesting are arriving from camera marksmen. First awards and first prize-winning pictures will appear in April.

Three Prizes Monthly for Ten Months

First.....$25
Second.....$15
Third.....$10

Keep Your Eyes Open, Your Camera Loaded THEN SHOOT!

"Strong Man" Is Weakling Compared with Insect

WEIGHT for weight, the most powerful professional "strong man" is a weakling compared with many common insects. If our legs had the same relative power as those of a flea, for example, we could jump with ease over a church spire 300 feet high.

An ant moving a heavy pebble up a little slope of earth is performing a feat equivalent to that of a man pulling a railroad train along the track single-handed. Ants have frequently drawn little wagons 1400 times as heavy as themselves.

Even the weakest beetle can lift five times its own weight. The rove beetle has

The original "strong man." The beetle can draw 45 times his weight

drawn a cart 45 times its own weight, and has lifted 1800 times its weight in escaping from beneath the cover of a tin can.

An ant, caught up by its hind legs with pincers, has been known to lift a small lead ball, into which it has bitten with its mandibles, high into the air. As the ball weighed 800 times as much as the ant, a man with strength in proportion could lift 40 tons.

THAT bright lights attract people was recently proved on the New York subway. On some local trains alternate cars had 25 per cent more light than the others, and these were invariably filled first, sometimes being crowded when the next car was almost empty.

What City Will Floods Wipe Out Next? Dayton's New Dams Show How It Could Be Saved

Vast Catch-Basins, Guarding Ohio Towns, Cost Less than Deluge

Conduits in the bases of the dams allow no more water to pass than can be carried safely in the river channels. The high velocities at which the water emerges are broken up in the hydraulic jump below the exit

WHOLESALE death and destruction by flood menace hundreds of American communities to-day. Yet the inhabitants are apparently heedless of their peril.

The great flood catastrophes that have almost wiped out some of our large cities in the past have been alike in one respect—in each case the stricken community had taken seemingly adequate precautions for ordinary flood conditions. But when the extreme storm came, ordinary precautions gave way before the full force of nature's torrents.

This very failure to provide against maximum flood is certain to result in dozens of other disasters in the United States in the future unless cities now menaced provide adequate protection. Leading the way in this direction are Dayton and neighboring towns of the fertile Miami valley in southwestern Ohio, which nine years ago were visited by a much more disastrous flood than had ever before been known. The thriving cities of Piqua, Dayton, Middletown, Hamilton, and others, suffered all the agonizing and destructive effects of flood waters such as were more recently experienced in Pueblo, Colorado. The cost of the disaster to Dayton was $67,383,574.

But to-day the people of the Miami valley are safe for all time to come from a repetition of such a disaster. Five large earth dams, really artificial hills, forming huge retarding basins, supplemented by many miles of local channel improvements in the principal cities and towns, fully protect the people from the greatest flood nature can produce!

The completion of this system of flood-retarding basins and auxiliary channel improvements marks an era in the progress of flood prevention. While the principles involved have been used to a limited extent in earlier works, no similar complete system has ever before been built in any country in the world. The work of construction was carried out during the war.

The dams cause the flood waters to back up over the lands above to depths as great as 100 feet, depending on the size of the flood and the particular dam, allowing the carefully designed conduits at their bases to pass only enough water to fill the improved channels below. As the flood passes, the excess waters in the basins are gradually discharged until the basins

The $67,000,000 Dayton flood cost 400 lives

Twelve American Cities Are "Flood Danger Spots!"

THE $15,000,000 Pueblo flood, which cost 55 lives, is still fresh in our minds. It is just as like'y as not that this spring may produce a similar disaster on an even larger scale—perhaps in *your* town. Engineers know of at least a dozen important American cities which are under the constant menace of destruction by floods.

The novel system by which Dayton, Ohio, has now insured itself against a repetition of the catastrophe that wiped out over 400 lives in 1913 is described for the first time in popular form in the accompanying article. Read how the Miami va ey system of catch-basins is expected not only to safeguard the val ey towns forever against inundation, but also to increase the fertility of the surrounding farms.—The Editor.

This $35,000,000 system of dams makes Dayton forever safe

This view from the top of one of Dayton's flood-preventing dams, shows how the water backs up on farmlands. Receding later, the water deposits a layer of silt, enriching the soil

are again empty. They then remain empty until the next flood.

Thus the so-called retarding basins are essentially dry reservoirs; and the lands within them may be farmed during the intervals between floods. There are no gates to be opened or closed when the rivers begin to rise; the action is entirely automatic and consequently foolproof. During low-water periods the rivers flow through the conduits without backing up at all.

How retarding basins operate during floods can be illustrated in any bathroom. Simply turn on the water in the bathtub, leaving the drain open. The water will flow into the tub faster than it can flow out of the open drain and consequently will slowly fill the tub. When its level reaches the level of the overflow, water will begin to flow out of that opening, and as soon as the total discharge of the drain and the overflow becomes equal to the discharge of the faucet the water in the tub will stop rising.

A Gigantic Bathtub

The surface will then remain stationary until the faucet is closed, when, of course, it will begin to fall and the tub will empty.

The bathtub corresponds to the retarding basin; the stream from the open faucet to the river flowing into the basin; the water going out of the drain to the flow through the conduits under the dams; and the water passing out of the overflow to the water flowing over the spillways.

However, in the Miami valley basins the water will never reach the spillway levels; that is, the faucet will be turned off before the overflow comes into use. The basins are so large and the conduits so proportioned that the maximum flood Nature can produce will not be enough to raise the water to the spillway levels!

The total cost of the works, paid entirely by the property owners benefitted, was about $35,000,000. The improvements, extending from the Lockington dam on the north, to Hamilton on the south, benefit a territory over 100 miles long, extending southwestward to the junction of the Miami River with the Ohio, and involving parts of nine counties. Thirty-six thousand acres of flat bottomlands lie above the dams, ready to be flooded at any time.

Nearly 850,000 acre-feet of water can be stored in the basins below the spillway levels, enough water to cover 1300 square miles one foot deep. To fill the basins to such heights would require a flood 40 per cent greater in volume than the one that occurred in March, 1913. The rainfall investigations carried on by the flood-prevention engineers, which were more thorough and more extensive than any ever before undertaken, showed that such a flood can never occur.

The dams contain about 8,500,000 cubic yards of clay, sand, and gravel, enough to cover 5000 acres of land one foot deep. Their outlet works contain 200,000 cubic yards of concrete. The highest dam is 125 feet above the bottom of the river and nine tenths of a mile long; the lowest is 73 feet above the bed of the river and six tenths of a mile long. At the bottoms of the valleys the dams are from 400 to 800 feet thick, depending on the height. Where they cross the river channels concrete conduits are constructed of such dimensions as to hold back all water in excess of the amount the improved channels below can safely carry.

All dams are 25 feet wide at the top, and carry highways from hill to hill. The river channel improvements cover a total length of 25 miles and involved the excavation of 5,000,000 cubic yards of material. The execution of the plans required the rebuilding of 25 miles of trunkline railroads, 10 miles of electric traction lines, 22 miles of public highways, 36 miles of telephone and telegraph lines, and many costly highway and city bridges.

New Engineering Problems

The design and construction of the works involved engineering problems never before investigated. The determination of the maximum possible flood, the design of the concrete conduits under the dams, the hydraulic design of the basins, the problem of dissipating the energy of the rapidly moving water as it emerges from the conduits, the method of building the dams, were all engineering features requiring special investigation or experimentation. So unusual have been the engineering studies and the construction methods employed that the work has been visited by eminent engineers from all parts of the world.

Probably the most difficult problem encountered in the design of the dams was that of breaking up the terrific force of the water as it comes out of the conduits. During moderate floods the water emerges

Will the Next Flood Disaster Strike YOUR Town

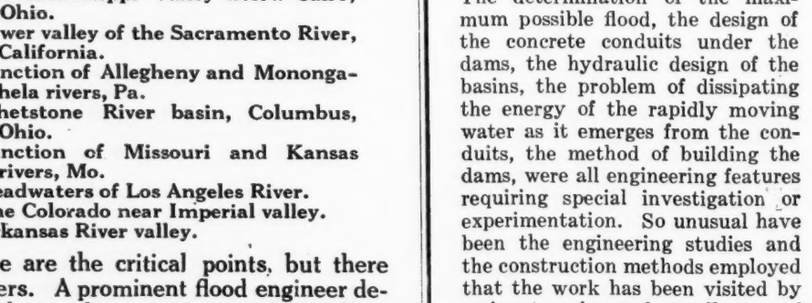
ONE flood—the disaster of March, 1913—cost Dayton $67,383,574. By expending only $35,000,000 a second disaster is made impossible. But there are other flood danger points. Many communities have been inundated. Several have made some attempts at protection, but as yet none has provided the protection that will safeguard them against the greatest imaginable flood.

The following points are declared by engineers to be America's chief danger spots:

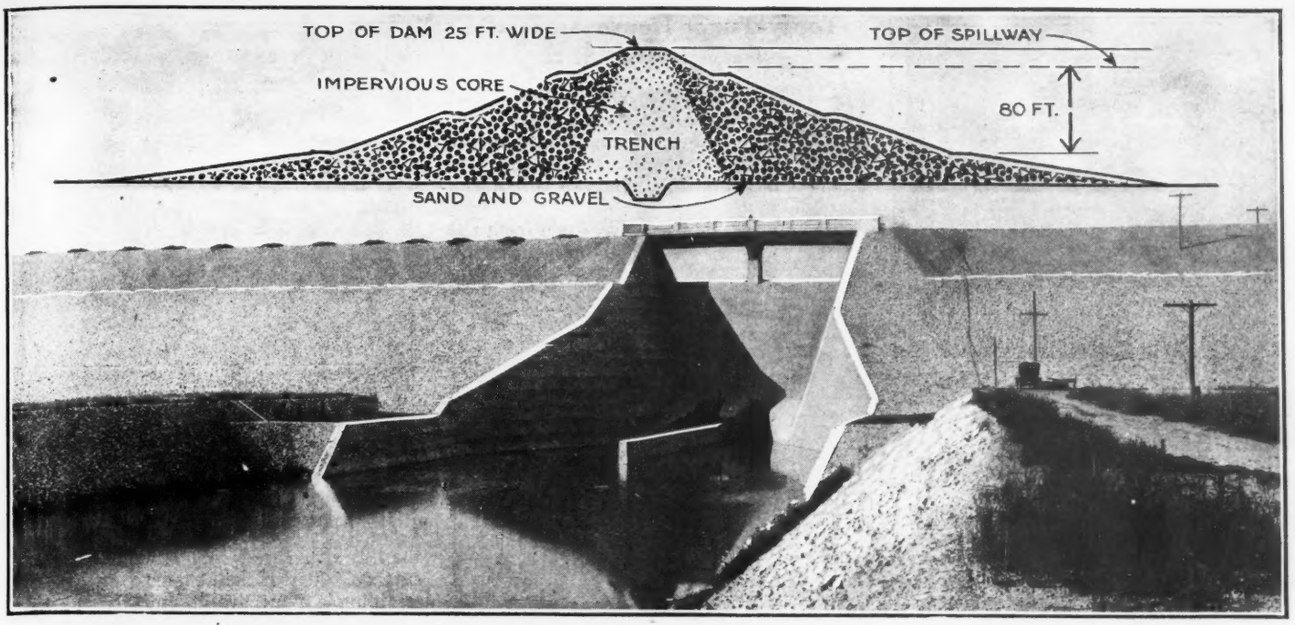
1. The Mississippi Valley below Cairo, Ohio.
2. Lower valley of the Sacramento River, California.
3. Junction of Allegheny and Monongahela rivers, Pa.
4. Whetstone River basin, Columbus, Ohio.
5. Junction of Missouri and Kansas rivers, Mo.
6. Headwaters of Los Angeles River.
7. The Colorado near Imperial valley.
8. Arkansas River valley.

These are the critical points, but there are others. A prominent flood engineer declares that unless a certain upstate New York city takes precautions, it will be visited by a flood worse than Dayton's.

Will the next disaster be in your town?



By the hydraulic fill method of dam-building, a mixture of sand, gravel, clay, and water is deposited at the edge of the embankment. The sand and gravel settle, while the clay goes to the pool in the center, forming an impervious core



To fill the retarding basin to the top of this concrete spillway would require a flood 40 per cent greater than that of March, 1913. And research has revealed that the greatest possible flood could be only 20 per cent greater. How the hydraulic-fill earth dams are built to form retarding basins is described by the cross-section diagram above

at a speed of about 25 miles an hour. If it were allowed to enter the natural channels immediately below at such a velocity, it would erode them and endanger the dam.

After a year's experimentation, a satisfactory solution of the problem was evolved, based on a phenomenon known as the "hydraulic jump." The water, as it leaves the conduits, flows down a series of steps into a wall of water, called the jump, caused by two concrete weirs immediately below and only about 40 feet apart. Between the jump and the lower weir the speed of the water is broken up so thoroughly by the obstructions that it flows away at a very normal velocity, the entire operation taking place in a length of only about 100 feet.

Five years were spent in making the necessary surveys, studying different plans of flood protection, designing the dams, and overcoming the legal obstacles. Four years were consumed in actually building the works. Thus nine years elapsed between the beginning and completion.

The dams were built by the hydraulic-fill method, one of the greatest engineering developments of recent years. In such construction the material to build the dam is washed into place by running water from hillsides above, or is pumped into place through long pipe lines by huge dredge pumps. The mixture of clay, sand, and gravel with water is deposited at the edges of the embankment, which are kept higher than the center; and the water, draining toward the center, deposits first the gravel, then the sand, and then the clay, thus giving the ideal structure for a dam—porous outer portions with an impervious core.

When the mixture is pumped, the material may be delivered to the pumps by cars or by running water from higher elevations. All of the different methods known were used in the Miami Conservancy operations, some of them being developed to stages much nearer perfection than ever before attained.

Flood protection is not the only benefit derived from the construction of the dams. During each flood the backwater within the basins deposits a thin layer of silt that increases the fertility of the soil. It is expected that due to this gradual deposition the fields will some day become equal in fertility to the lands along the Nile, where continual cropping is practised without the use of manure or fertilizer and with no detrimental effect on the soil.

Meter Times Phone Calls

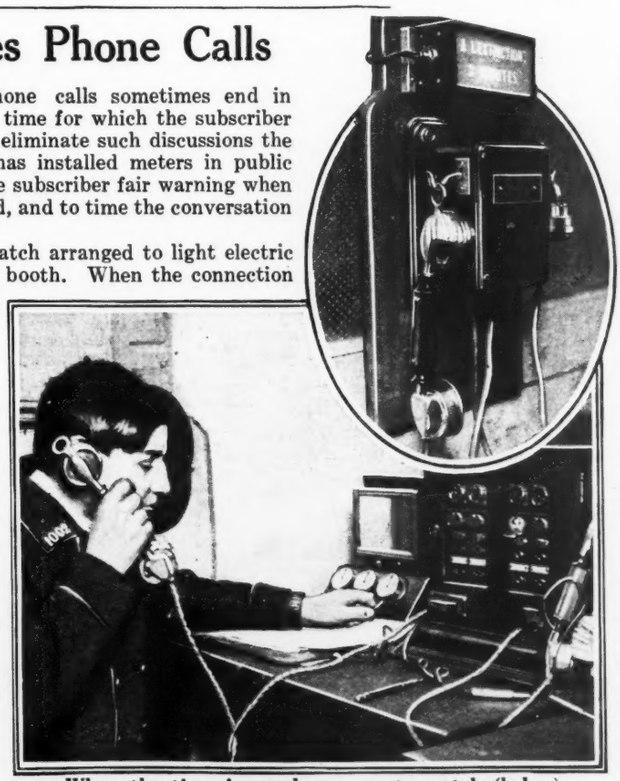
LONG distance telephone calls sometimes end in arguments over the time for which the subscriber should be charged. To eliminate such discussions the French Postal Service has installed meters in public phone booths to give the subscriber fair warning when his period is about to end, and to time the conversation mechanically.

The meter is a stopwatch arranged to light electric signals in the telephone booth. When the connection is made, the central operator plugs one of the jacks into a connection on the timer, which cannot start until the line is clear and ready for use.

Two minutes and a half later, the hand of the watch makes a connection for two lamps hooked up in series, one of which lights in the central office and the other over the public telephone. This light warns the speaker that his time is nearly up.

Exactly at the third minute, the lamp is extinguished. If the subscriber continues to talk, he must pay for an additional period. The telephonometer makes a second revolution, and 30 seconds before the end of the second period gives the same warning as before.

Thus far, the meters have been installed only in public telephone booths. The instrument is said to be of service to the public, since it enables the subscriber to gage his time automatically.



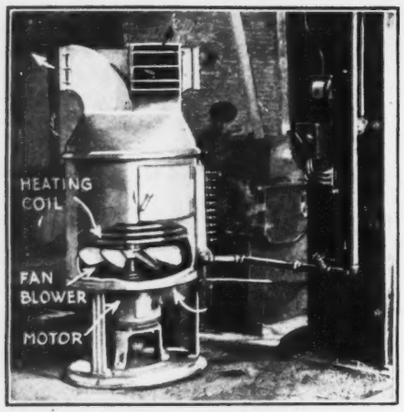
When the time is nearly up, a stopwatch (below) lights an electric warning signal in the telephone booth (above)

A Dam Built of Marble!

THE largest artificial lake in Asia, formed by a magnificent dam built in India by coolie and elephant labor nearly 280 years ago, will be described in the next issue.

Traveling by elephant into a region rarely penetrated by Occidentals, Eleanor Maddock, wife of an American physician, who writes the article for POPULAR SCIENCE MONTHLY readers, discovered interesting details of the primitive methods by which this marvel of beauty among reclamation projects was constructed.

You will enjoy comparing, next month, the pictures of the Jaisamand dam with those of present day engineering feats, such as are described in the foregoing article.



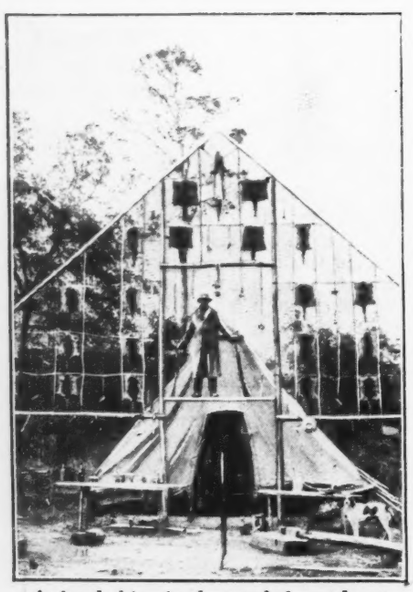
Steam Heating Unit for Shop Is Also a Ventilating Plant

A POWERFUL blower, placed beneath compact steam-radiator coils forms a compact unit that both heats and ventilates large factory floors. The steam coils are shaped like those in instantaneous gas-heaters affording a large radiating surface. A novel improvement has been effected by the introduction of a header pipe connected with all the coils. A valve placed on each coil makes it easy to regulate the amount of heat produced by the unit.

A belt or electric-driven fan draws the cold air from the floor, and forces it through the coil. At the top of the unit four ventilating tubes send the currents of warmed air to different parts of the shop. This results in a constant circulation of air without pipes or ducts that might interfere with belting or the shop machinery.

A pipe leading outdoors converts the unit into a ventilator when required.

Proves that Georgia Is Good Trapping Country



Animal skins in demand throughout the world are on display at this hunting camp

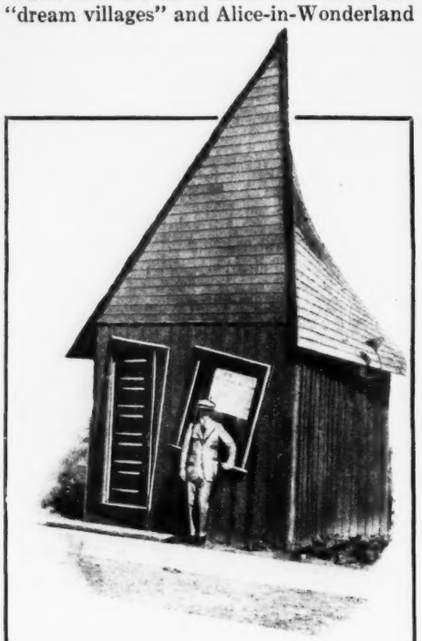
A SMALL part of the season's fur catch of J. L. Glaze, of Vidalia, Georgia, is shown in the above picture. The square ring-tailed furs are raccoon, which are of great commercial value in the United States, while the smaller skins are opossum, for which there is a brisk demand in Europe.

The various traps and decoys used are shown between the skins in the illustration.

Topsy-Turvy House Advertises Real-Estate Office

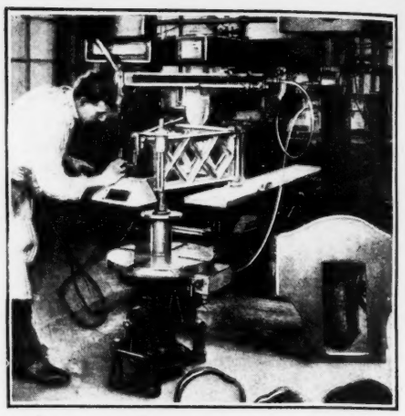
BELIEVING that a grotesque building would have decided advertising value, a California real-estate company recently built its field office with a twisted, sagging roof, and doors and windows set out of plumb.

The idea is said to have come from the "dream villages" and Alice-in-Wonderland towns that have been a feature of amusement parks for many years. As far as is known, this is the first time the idea has been applied in the business world.



The owner built his odd shaped office to attract attention to his business

If there are questions in general science that have been puzzling you, send them to the Editor. On page 62 you will find the rules and regulations governing this service together with a number of questions that have been submitted by readers



Oxyacetylene Cutting Torch Works Automatically

OXYACETYLENE cutting can now be done automatically, even on irregular shapes, with a new machine in which the cutting torch is attached to an arm resembling a pantograph, guided by a thin wooden template. The accuracy of the device is such that the flame may be used to cut gear-teeth. As a matter of fact, it is said that the cut may be controlled to a few thousandths of an inch, so that the work turned out is ready for finishing on the lathe.

Naturally, the shop economies possible with such an invention are remarkable. No highly skilled labor is required, and it is claimed that 15 inches of half-inch plate can be cut accurately in any shape in less than one minute at a cost of less than one cent for oxygen. The cutting flame is enclosed in a fireproof metal box.

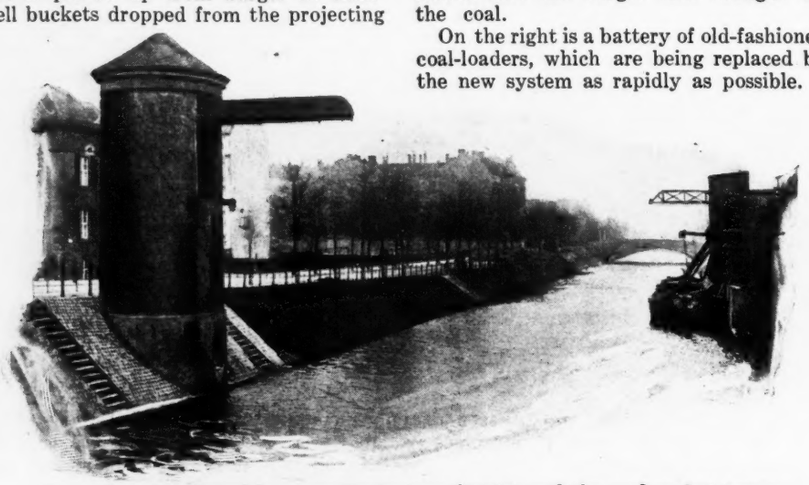
HOT nitrogen gas of high purity has been discovered in one of the lead-silver mines of Utah.

It is believed by the Bureau of Mines that the automatic extraction of the oxygen in the air through the oxidation of sulphides was the cause of the phenomenon. The gas had a temperature of 175° F., although the air three feet below registered only 135°. Several samples of the gas averaged 99½ per cent pure nitrogen.

Subway Road Carries Coal from Canal to Factories

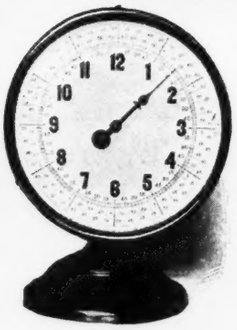
WITHOUT spoiling the appearance of a residential street or depreciating property values in the neighborhood, coal-loading machinery has been installed on the canal at Neukölln, Germany. The coal is picked up from barges in clam-shell buckets dropped from the projecting beam, and falls through the tower into underground cars. These carry the coal to the stoking-rooms of large factories in the vicinity, and on the return trip the ashes are carried back to the canal and loaded into the barges that brought up the coal.

On the right is a battery of old-fashioned coal-loaders, which are being replaced by the new system as rapidly as possible.



An underground road between the factory district and the coal pocket tower on the canal bank is used to cart coal and ashes in Neukölln, Germany

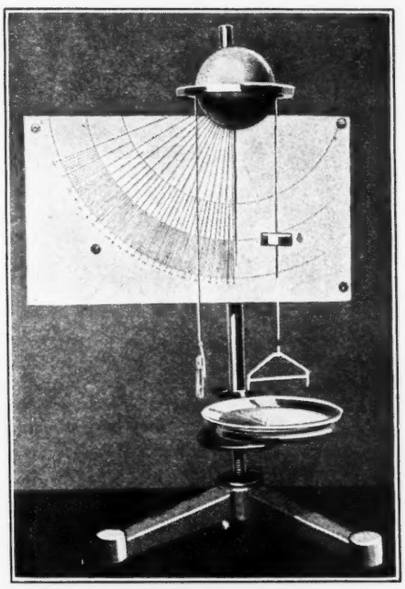
One Hand Watch Tells the Time Accurately



A new type of clock has an hour hand and a special dial

WE shall have to learn to tell time in a new way, if a one-hand watch, recently patented comes into general use. The watch has no minute hand. Instead, a special dial makes it possible to read the minutes accurately from the position of the hour hand. Children can learn to tell the time two years earlier with this watch, it is claimed. As there is only one hand, very little calculation is required.

How Tough Is the Skin on the Surface of Water?



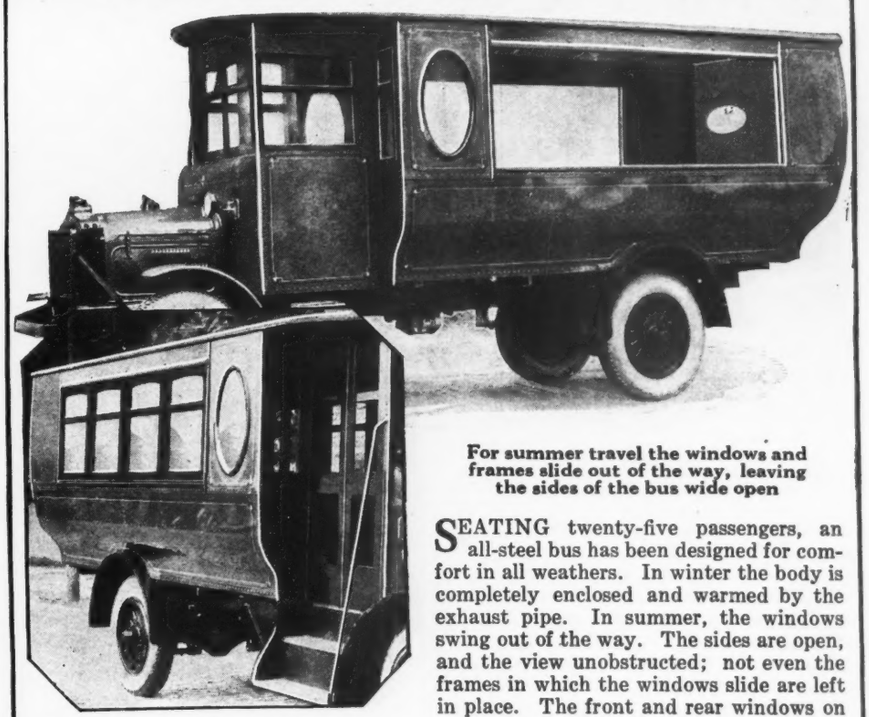
This sensitive scale measures the minute force of surface tension on water or other liquid

EVERY one has floated a needle on the surface of a glass of water, or watched a bit of camphor skim from side to side of the glass. These simple experiments were to prove the existence of surface tension. Now comes A. W. Fahrenwald with an instrument that will measure the force of surface tension on any liquid and tell us just how tough the "skin" of water is.

The liquid in the watch-glass is raised until its surface comes into contact with two knife edges ground on the bottom of the triangular bar. The glass is then lowered, and a plane film is drawn out. Tension in this film rotates the indicator, which is a light wire fastened in a two and a half inch cork wheel. The forces measured are so slight that all parts of the apparatus are made as light as possible.

In measuring the tension of water, the pointer first swings to the 80-dyne graduation as the upper surface of the horizontal bar breaks through the surface film. As the liquid is lowered farther, the film is drawn from the lower knife edge, and the pointer rises to 92.85 dynes, which is the correct reading.

All-Weather Bus Comfortable the Year Round



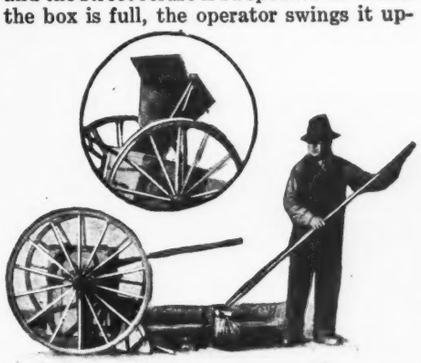
For summer travel the windows and frames slide out of the way, leaving the sides of the bus wide open

In winter the tightly closed bus is heated by gases from the exhaust pipe

SEATING twenty-five passengers, an all-steel bus has been designed for comfort in all weathers. In winter the body is completely enclosed and warmed by the exhaust pipe. In summer, the windows swing out of the way. The sides are open, and the view unobstructed; not even the frames in which the windows slide are left in place. The front and rear windows on each side are hinged, and when not in use can be concealed in the panels.

New Street-Cleaning Buggy Provides Own Shovel

A STREET-CLEANER'S cart that fills itself enables the White Wings of San Francisco to leave their shovels at home. Pivoted on the axle is a combined shovel and collection bin, from which extends a long handle for the operator. When in use, the bin rests on the ground, and the street refuse is swept into it. When the box is full, the operator swings it upward on its pivot and dumps the sweepings.



A shovel shaped pan swung from the buggy axle takes the place of the usual scoop

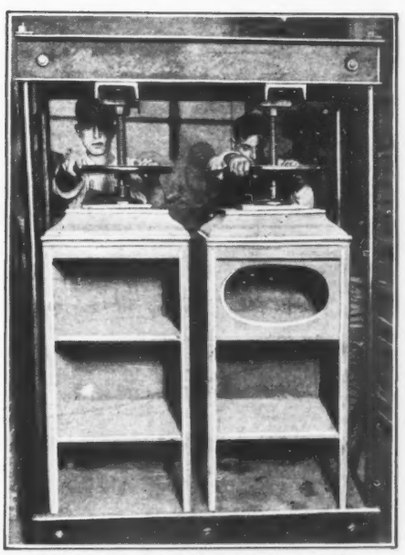
The cart is pushed or pulled by the handle. The weight and braking action of the swinging box as it rests on the ground is sufficient to hold the cart steady.

COMPRESSED air was used to fish an electric wire through a long conduit in Los Angeles, California, where a distance of 450 feet between outlets made the usual methods impractical. A pneumatic fishing machine was used with a special cord of heavy fish-line. An incidental advantage was that, during the operation, all dirt and foreign matter in the pipe was blown out by the air.

Heavy Pressure Used to True Up Phonographs

FORCEFUL measures are used in one phonograph factory in order that the cabinets may stand solidly on their feet —for it is known that the slightest looseness in the frame seriously injures the tone of the instrument.

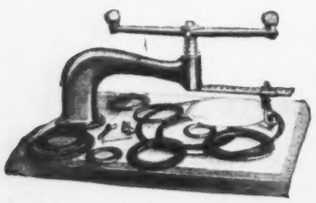
In this particular operation, a pressure of about five thousand pounds is applied to the top of the cabinet with a hand screw. The steel floor of the pressure-frame is very carefully levelled, so that if the cabinet has not been made square and true in every dimension, the fault is corrected when the pressure is applied.



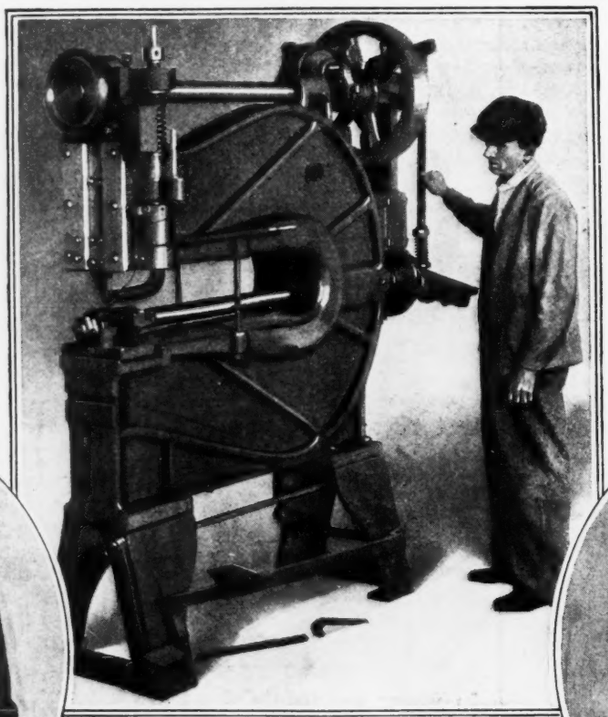
Set screws exerting a tremendous pressure are used to level up phonograph cabinets

Two of the cabinets are pressed in the frame at one time.

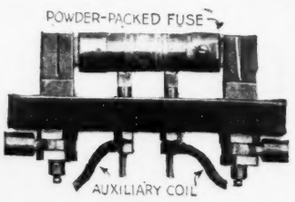
Which of These Time-Savers Do You Need?



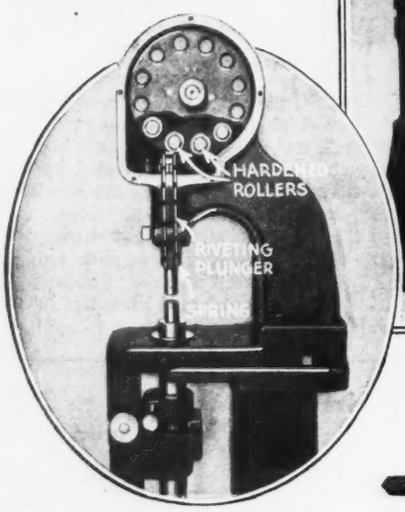
Gaskets and washers of leather, rubber, metal, or other material are quickly and accurately cut with the aid of this compact little rotary cutter



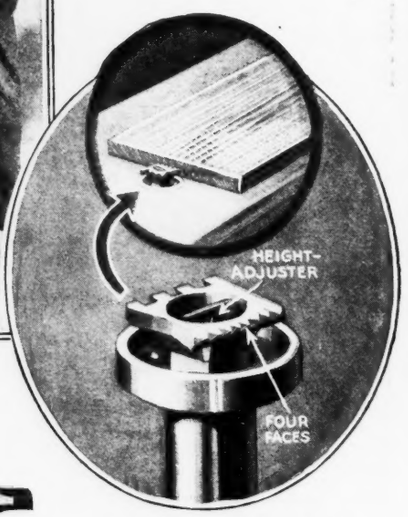
Iron plates, five eighths inch thick, may be cut easily with this machine, which has rotating cutters working under tremendous pressure and constantly lubricated. The machinist guides the metal by hand



This recently invented multiphase fuse is renewable and will protect multiphase motors and circuits on starting and running loads from burning out when a fuse blows

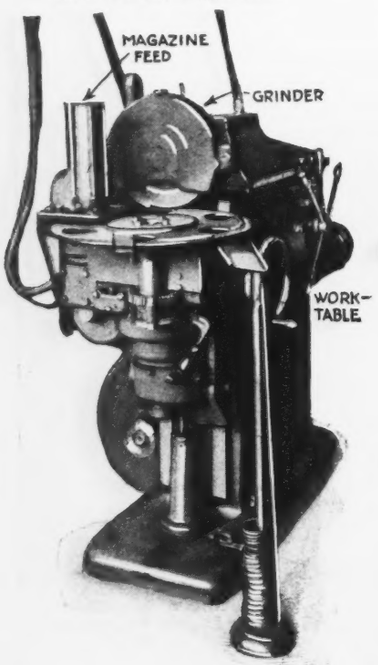


With a spindle speed of only 1200 revolutions a minute, the riveting machine shown above will strike more than 14,000 blows without severe strain on the mechanism

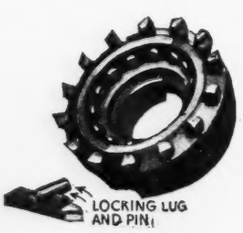


Every carpenter's bench needs a bench-stop against which boards or strips may be braced during planing operations. The stop shown above, when not in use, is set flush with the bench-top. It may be set at different heights

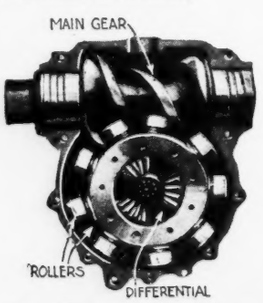
As the shank of a reamer will outlast many blades, the idea of making the shank part separable from the blade part by a screw joint will result in economy



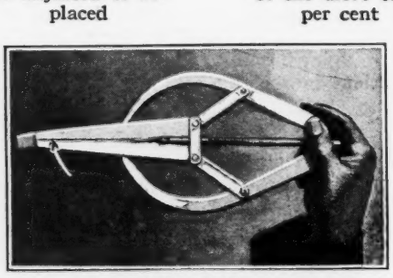
Piston-rings are fed automatically from a magazine to the rotating worktable of this grinding machine. After being ground they drop to the receiving spindle



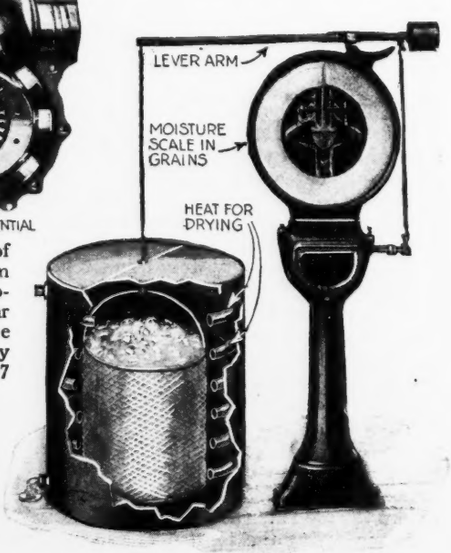
In this new face-milling cutter the teeth are positively locked so there is no chance of their slipping or becoming loose under strain. They may be adjusted or replaced



Rollers instead of teeth in the worm of the new automobile driving gear pictured above bring the efficiency of the drive to 97 per cent



Springs automatically hold the legs of this new type of calipers in contact with the object to be measured



For measuring the percentage of moisture in wool, the scale pictured above has been invented. The percentage is registered directly on the calibrated dial, requiring no mathematical calculations

Here's the House that "Jacks" Built!

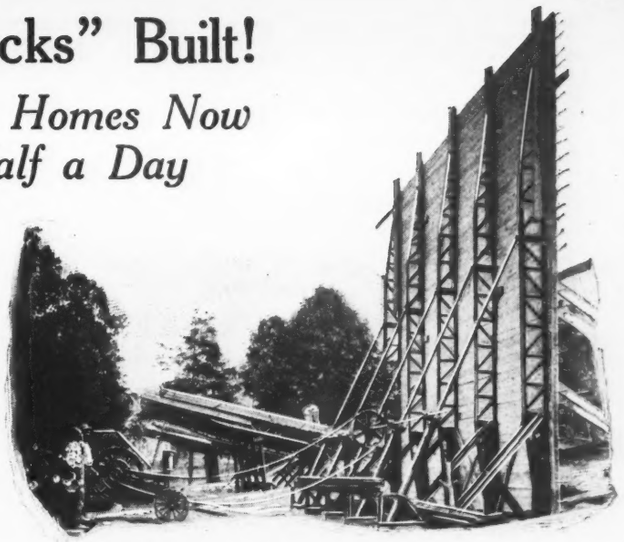
Complete Walls of New Concrete Homes Now Raised by Screw-Jacks in Half a Day

A GASOLINE engine tugs; giant screw-jacks slowly stretch their necks, and up goes the entire side of a building—all complete, with windows, cornices, moldings, and decorations!

At noontime, four solid concrete slabs lie flat on a building-lot. At evening, as if by magic, the four walls of "the house that jacks built" stand in place. And so has come about a revolution in home-building methods that may make concrete houses as cheap as frame construction.

The erection of a concrete building in one afternoon is accomplished, not by a magician, but by a carefully planned, scientific system of construction, invented by Col. Robert H. Aiken, of Washington, D. C., and executed by Snowden Ashford and Carroll Beale of the same city. The work is completed without the use of forms and scaffolding, and without "pouring" the concrete in the customary way. This is how it is done:

The basement floor is laid in the usual manner, and finished smooth to a level. The hoisting-jacks and trusslike girders are alined in front of this floor, and upon the girders loose planks are laid transversely, until a platform the size of a side wall has been built. All the window- and door-frames are laid on the platform, and concrete is poured around them. At the same time all the details of the completed wall are cast in place, either by nailing an insert or print-block to the platform, or by carving a design into it, according to whether the ornament is to project from the wall or not. The four walls of a concrete house of ordinary size can be molded in about two hours. The concrete on the platform for each wall is then allowed to set for three days, until it becomes thoroughly dry and hard.

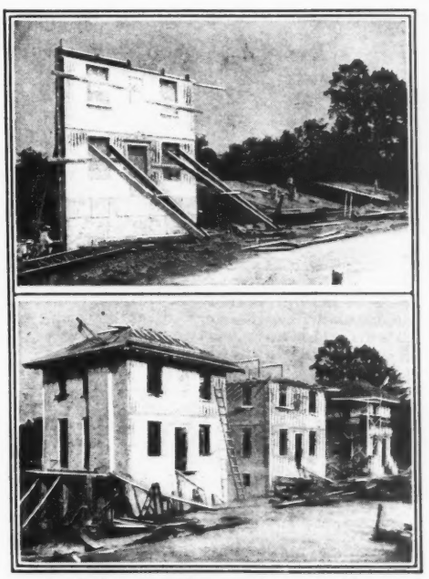


Here is the front wall of a house jacked to a vertical position. Note how the five telescopic screw-jacks are geared to a common shaft, driven by a small gasoline engine

Walls Rise without a Break

Next comes the hoisting of the walls. By means of a common driving-shaft, all the jacks are connected with a low-power gasoline engine, and as this is started the platform and wall, pivoting on one edge, rise slowly into place without any risk of breaking during the ascent or of rising past the vertical and falling in the other direction. Such mishaps are made impossible by the careful designing of the jacks and guides.

Telescopic screw-jacks, set from six to eight feet apart with the toe of each jack resting on the footing of the foundation, are raised by screws turned by bevel gears from the common shaft, so that one jack never extends faster than its neighbor. While the planks of the platform might keep the wall from cracking if this should happen, the inventor relies upon purely mechanical methods for controlling the rate of ascent.



A whole row of houses is erected by a single crew in a day. Above—One wall is up, while two others in the background are ready to be raised. Below—Tied together by poured corners, the walls become dwellings

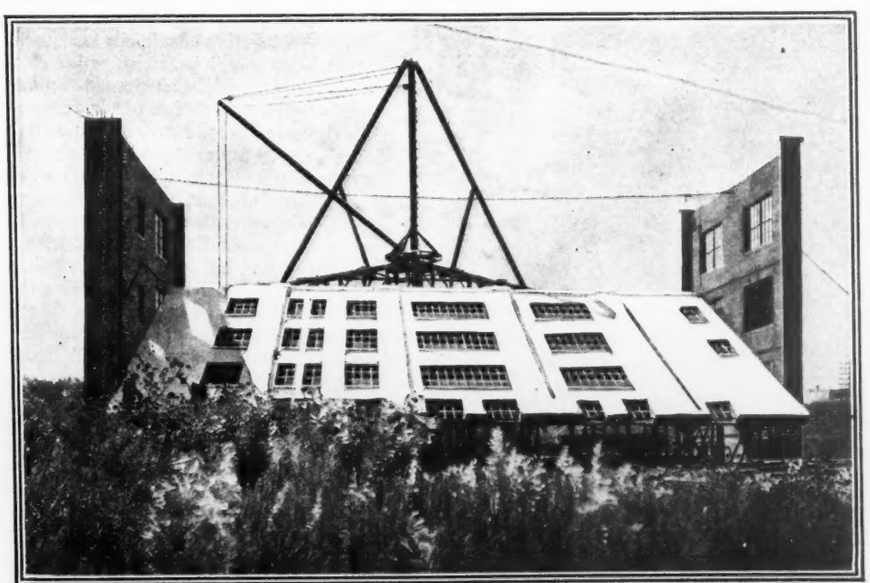
Exterior Is Waterproofed

To reduce the weight, and to prevent moisture from condensing on the inside of the walls of the completed house, a concrete mixed with coke braize and cinder has been adopted. Several years of experience have proved that this material has ample strength, yet is porous enough so that nails can be driven into the inner side. The outer section is made waterproof with a two-inch layer of concrete.

Once erected, the walls are united at the corners by casting pillars of concrete at the joints. This is easily done, because in making the wall, the iron reenforcing-rods are allowed to project about 30 diameters. As they interlace when the walls come into position, it is not difficult to pour the concrete corners around the iron reenforcing-rods.

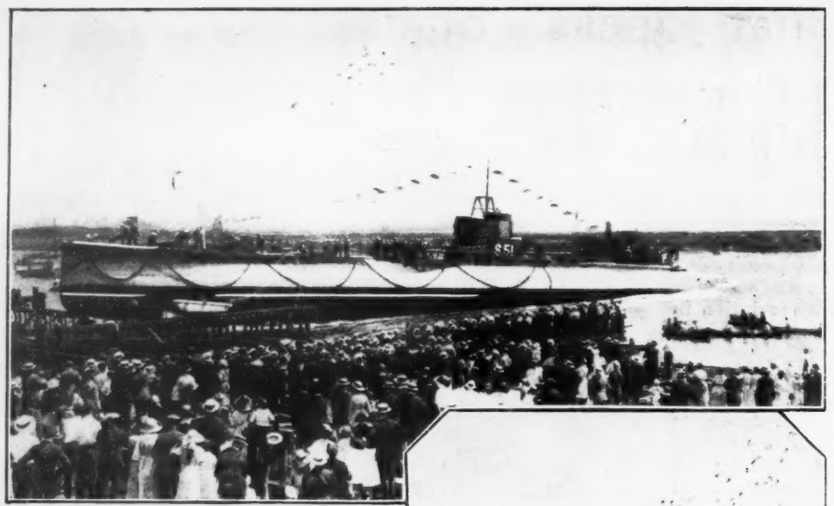
The walls are usually laid out in the interior of the building before raising, but they may be placed outside if space permits and if it is desirable to raise all four walls at once.

With this method it is possible to raise an entire factory in a day, or to build an entire row of houses at one time. In the latter case, three or more fronts are raised one after another during one working-day, with one crew using the same equipment. In addition, the method makes it possible to build an elaborate concrete house with nothing but common labor. Only one plasterer is required for finishing the corners. The elimination of form work and every sort of elaborate finishing is expected to make concrete-walled houses cheap enough to compete not only with brick, but even with wooden frame construction.



The 50-foot wall of a factory, including windows, goes up without a crack. The photograph gives an idea of the immense power of the erecting system

FOR further information concerning the houses described in this article, or for answers to other questions in general science, write to the Information Editor (see page 62).



The S-51 is a double-hulled submarine, embodying all the latest improvements

Pigeons Herald Plunge of New Submarine

CLOUDS of carrier pigeons rose from the decks of the United States submarine S-51 as she was launched into the waters of Long Island Sound, at Bridgeport, Conn. The pigeons circled twice over the hull as it floated out into the sound; then they started off in all directions to broadcast the news that the launching had been successful.

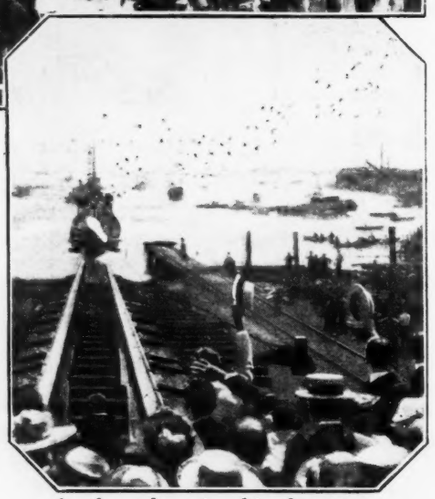
The S-51 embodies the improvements in submarine construction learned during the world war. In cruising radius, armament, signaling apparatus, and arrangements for the comfort of the crew, she marks a great advance over the underwater craft of three years ago. A sister ship recently made an 8600-mile cruise from Portsmouth, N. H., to Honolulu. These long voyages are possible because of the large size of the later submarines.

The length of the new vessel is 240 feet over all; beam, 21 feet 6 inches, and draft, 13 feet in normal surface condition. The displacement is 993 tons. The vessel is of the double-hulled Lake type for one half the length amidships; while the forward and after portions are of the well known single-hull type.

Safe at 200-Foot Depth

The S-51 can submerge safely to a depth of 200 feet, and is driven on the surface by two Diesel engines, each of 950-brake horsepower. Storage batteries and electric motors drive the ship when submerged. There are three periscopes, for the reason that during the war it was found that periscopes were frequently shot away. One periscope with its eyepiece in the conning-tower is carried on an elevator platform so that the observer, by moving up and down inside the hull, can keep the end of the periscope just a foot or two above the surface. The other two periscopes lead to the control room.

Improved radio apparatus is installed for use both on the surface and when submerged. Submarine coils are provided so that radio messages from the fleet can be received when the submarine is under water. A 14-foot lifeboat and a 4-inch gun are carried.

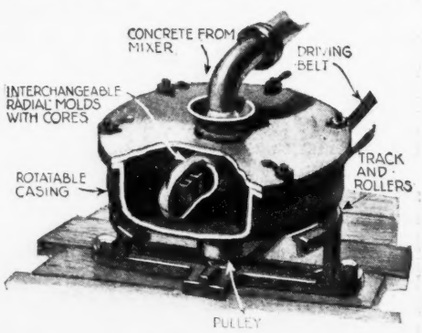


As the submarine hit the water, hundreds of pigeons rose from her decks and flew in every direction to carry the news of the successful launching

Rotary Machine Casts Concrete Shapes

SOLID concrete shapes can be successfully cast on a new centrifugal machine that will turn out four blocks every 60 seconds. A revolving table carries hollow molds into which concrete is fed by centrifugal action through a central orifice. Excess water is squeezed out by centrifugal force during the spinning. The amount of water in the finished product may be governed by regulating the speed of rotation.

Hollow articles may be cast by placing cores in the mold. Similarly, the blocks may

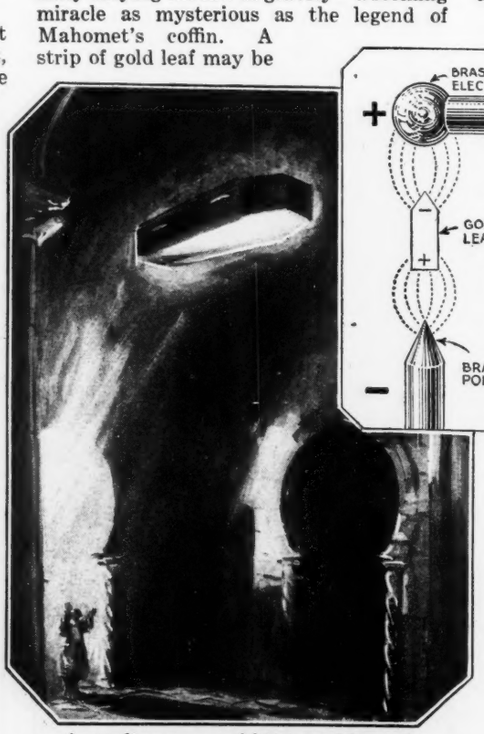


be reenforced by wires stretched across the interior. In both cases the concrete tends to pack solidly about the obstruction.

Filling the molds is completed in from 30 to 60 seconds. The mold is then opened along its bottom, and the shape falls on an endless belt, which carries it to the drying stacks. When the shape is cast, there is usually a finlike projection from the mold into the central chamber. A cutter sliding up and down the walls of the feed-chamber removes this from the completed shape.

You Can Rival Mahomet's Coffin Mystery

WITH the simplest of apparatus you can perform an experiment apparently defying the law of gravity—a seeming miracle as mysterious as the legend of Mahomet's coffin. A strip of gold leaf may be placed between two charged rods—and it will remain there, hanging in the air without any visible support.



According to an old Oriental legend, Mahomet's coffin was suspended in midair by a huge magnet

If a brass conducting-rod with a brass ball on the end is continuously charged with positive electricity, and a pointed conductor placed a few inches below it or held in the hand, a piece of aluminum or gold leaf placed between them will remain balanced in midair as long as the rods remain charged.

Negative electricity exists in very small particles called electrons, which are free to move under the action of electromagnetic forces. Particles of positive electricity are not free to move. Adding electrons to an uncharged body gives it a negative charge, while removing electrons from an uncharged body leaves it with a positive charge.

The positive charge in the upper electrode draws electrons to the pointed top of the strip of gold leaf, leaving the lower end positively charged. This charge in turn draws electrons from the pointed conductor below. If the strip moves upward the stronger attraction causes it to lose more electrons from its point while it gains less from below. Hence the force on the strip weakens and it settles back into a position of equilibrium. If examined in the dark, the gold leaf is seen to emit sparks, showing a continual loss of electricity.

What Is Your Question?

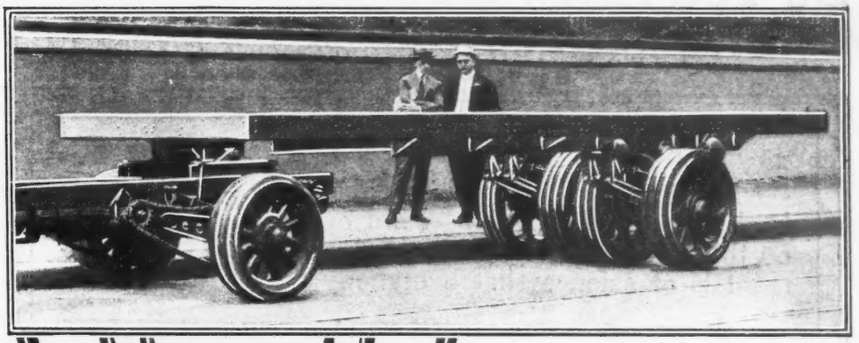
Scores of POPULAR SCIENCE MONTHLY readers are receiving useful advice daily from the Information Department (see page 62). Every variety of practical problem is promptly answered. Why not put *your* question up to the Information Editor?

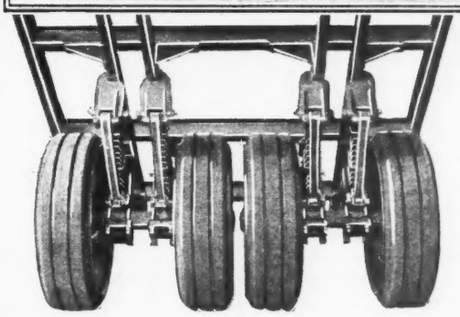
The Mirror Is Full of Cheer—Just Unscrew the Handle

NO one can fail to be cheerful after a glance in this mirror. For—you will promise to keep the secret—its handle will unscrew, and between the glass and the silver case there is a hollow space big enough to hold three fingers of comfort. The mirror has been manufactured so that a woman may have a convenient place to keep perfume or smelling salts.

The handle unscrews, and the inside of the mirror contains perfume

Here's a Trailer that Helps the Roads!





When the novel trailer is attached to a truck, as shown above, the load is distributed over six wheels. At the left may be seen the shock absorbing springs for each wheel

FOR a 20-ton truck to improve every gravel road it passes over sounds like an engineering paradox; yet such an advantage is claimed for a freak four-wheeled semi-trailer recently constructed by a Detroit firm to refute the argument that the motor truck is destroying the nation's highways.

The use of four wheels in line gives a total tire or load-bearing surface of 48 inches and allows a load disposition of about 800 pounds to the square inch.

As attached to a truck, the load is distributed over six wheels, more than eight feet between centers, so that the trailer may be taken over any modern bridge without producing undue stresses. The four-wheel principle has proved so effective in practice that the manufacturer is now guaranteeing his product for a load of 40 tons.

Because of the unusual spring mounting, the trailer is not seriously affected by holes in the pavement. Independent double acting springs are provided for each wheel. If one of the wheels drops into a hole, the load instead of falling two or three inches and bringing up with a heavy jar, is shifted to the other three wheels, thus preventing sudden strain on the springs.

On soft roads the broad tires, it is claimed, consolidate the surface without breaking down the subgrade. The truck was designed especially for hauling heavy electrical machinery, flywheels, and structural steel, all of which are constantly increasing in size and weight.

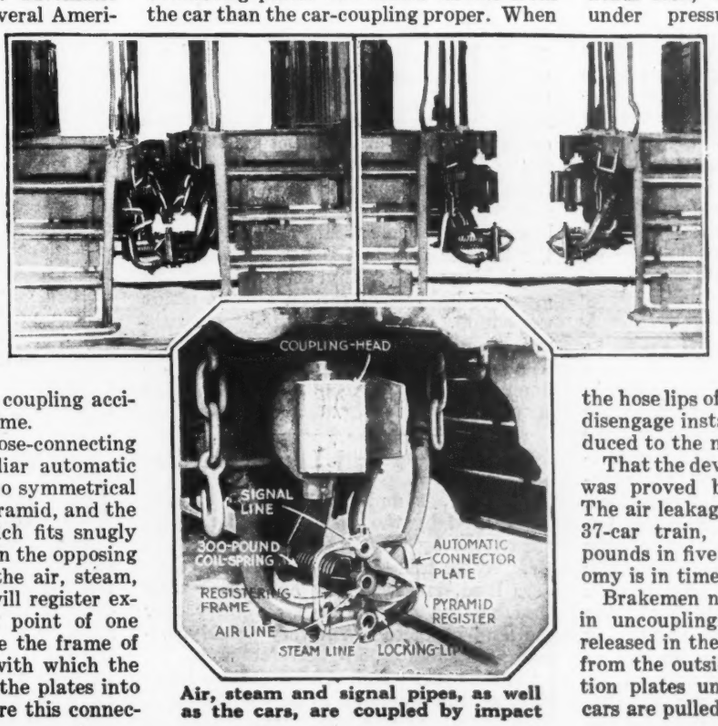
Automatic Coupling Will Save Time, Money, and Lives

A SUCCESSFUL registering device in the shape of a pyramid is now solving the problem of 100 per cent automatic coupling on railroad cars of several American lines. In other words, air, steam, and signal pipes, as well as the cars themselves, are coupled solely by impact.

These connections, set in the faces of the new-type coupling mechanism, are held tightly together by the pressure of 300-pound coil springs. No longer need the brakemen crawl between the cars to link the various hose ends. Thus, the universal use of the device will undoubtedly greatly reduce the number of coupling accidents, in addition to saving time.

On each car the automatic hose-connecting plate, placed below the familiar automatic car coupler, is divided into two symmetrical sections, one occupied by a pyramid, and the other by a hollow frame which fits snugly over the base of the pyramid on the opposing plate of another car. Thus the air, steam, and signal lines of two cars will register exactly, provided the pyramid point of one plate engages anywhere inside the frame of the other; for the pressure with which the cars come together will force the plates into the proper position. To assure this connection, the device has a range of seven inches.

Before coupling, the coil-springs hold the connecting plates two inches farther from the car than the car-coupling proper. When the cars come together, the shock compresses both springs, and as the coupling heads lock, the connecting plates remain under pressure. This pressure would wear out rubber pipe gaskets, so it is borne by four metal contact points on the faces of the connecting plates. The fluid pressure of steam and air is relied upon to keep the pipe-lines from leaking.



Air, steam and signal pipes, as well as the cars, are coupled by impact

To prevent excessive pressure in the steam lines from forcing the connector plates apart, the latter are cast with slight raises in the frames, resembling lips. These lips lock when steam pressure starts to separate the hose lips of the steam connection, but will disengage instantly when the pressure is reduced to the normal pressure of the springs.

That the device is practical and economical was proved by tests on many railroads. The air leakage is slight. In the case of a 37-car train, the highest loss was seven pounds in five minutes. The greatest economy is in time saved in coupling.

Brakemen need not crawl under the train in uncoupling, as the coupling heads are released in the familiar way by an iron lever from the outside of the car, and the connection plates unlock automatically when the cars are pulled apart.

Do You Know How Germs Make Food for Your Table?

Ten Everyday Wonders that Unlock the Secrets of Science

EVERY month POPULAR SCIENCE MONTHLY publishes 10 common questions about the scientific facts back of our daily lives. Find out from the answers on this page how well you really understand the fundamentals of science that everybody wants to know.

1. **Are bacteria always harmful? Are they ever useful?**
2. **Just how does the "weather man" predict the weather?**
3. **Why is yeast put into bread dough? Why is dough kneaded?**
4. **Why do we get sea breezes by day and land breezes by night?**
5. **Why is it better to breathe through your nose?**
6. **What is a calory? How many does a baseball player need a day? How many does a bookkeeper need?**
7. **What causes lightning and thunder?**
8. **What makes the heat inside of an electric iron?**
9. **Why does a blue flame appear on a coal fire when the stove door is opened?**
10. **Why does the air feel more invigorating on a clear day than on a damp day, even though both days are cool?**

Read the Answers Below

Five Minutes a Day Will Make You Master of These A-B-C's of Science

Some Bacteria Are Useful

1. Not all forms of bacteria are causes of disease. There are certain bacteria which produce changes in dead organic matter, such as rotting trees, leaves and bodies of animals, and these changes make the elements of the decaying bodies again available as food for plants. Certain bacteria, too, make the nitrogen of the air available for growing crops. Still others, which feed on the dead remains of plants or animals in the sea, are in turn eaten by larger, but still minute, forms of life. These are then eaten by still larger animals, and so on, until we get to forms of life that we can use as food ourselves; such as shrimps, fish and oysters.

How the "Weather Man" Does It

2. At 8 A. M. and 8 P. M. of every day in the year, 200 trained observers at 200 different stations scattered throughout the United States, Canada and Mexico, telegraph to the "weather man" at Washington certain readings and observations, including air pressure, temperature, humidity, wind velocity, direction of the wind, amount of rain- or snow-fall, and the kind of clouds in the sky. He records these facts on a map; then, judging by the wind velocity and its direction, and taking into account the other factors, as well as past experience with similar conditions, he predicts for any section of the country what the probable weather will be for the next 36 hours. Checking predictions with actual weather, the "weather man" seems to be right eight or nine times out of ten.

Why Dough Is Kneaded

3. If bread should be baked out of unkneaded dough, or without yeast or baking-powder, it would turn into a hard, indigestible mass. Kneading makes bread or cake spongelike in structure—that is, full of holes; for the process entraps particles of air, which expand during baking and puff up the dough. In the case of baking-powder, the addition of water causes the tartaric acid in the powder to act on the baking soda (sodium acid carbonate) to generate bubbles of carbon dioxide inside the dough. These, too, expand upon baking, filling the cake with numerous holes. The yeast, as it lives and grows in the dough, gives off carbon dioxide. The result on the dough is the same as before.

Sea Breezes and Land Breezes

4. All winds and breezes, except those caused by the rotation of the earth, are caused by the unequal heating of the air. Water takes longer to grow hot than does land, and will stay hot longer than land. When the sun shines, the air over the land becomes warm very quickly, expands, gets lighter, and therefore rises. To fill in the space which this air occupied, the air over the sea flows in across the land. This sea air is still cool, having been in contact with the water. Thus we have the cool sea breezes by day. But by night the reverse happens. The land cools quickly, but the sea retains its heat. The air over the sea rises and the land air rushes out to fill in the space left vacant.

How You Should Breathe

5. In correct breathing, air should enter as well as leave through the nose. The lining of the nose secretes a layer of mucus which catches fine dust particles before they can enter the windpipe. Hairs which line the nostrils also filter out the coarse dust particles. Furthermore, the long, narrow nose passages warm the incoming air before it reaches the lungs.

The Measure of Food Values

6. A calory is the unit by which heat energy is measured. It is defined as the amount of heat required to raise 1000 grams (2.2 pounds) of water 1° on the centigrade thermometer. Since food is changed into heat, all food values are measured in calories. A baseball player uses up about 6000 calories a day, while a bookkeeper uses about 2600 calories.

Lightning and Thunder

7. Every time you disconnect an electric circuit a spark jumps across the gap. Now, the air always has a great deal of electricity in it. Under proper conditions, this electricity will flow from one point in the air to another, causing a large electric spark.

As the charge of electricity tears its way through the air, great quantities of air are pushed to one side. After the passage, this air rushes back to fill the vacuum produced, thus causing the noise of thunder.

Inside of an Electric Iron

8. When an electric current passes through a wire, the wire becomes warm. A wire made of a certain well known alloy of nickel and chromium gets very hot upon the passage of current through it, yet can support high temperatures. This is the wire used inside of electric irons.

The Cause of the Blue Flame

9. When coal is heated in a confined space, instead of burning it decomposes without flame, because there is not enough oxygen to support burning. One of the products of this decomposition is illuminating gas. As you open the door the air rushes in, and soon there is the proper mixture of gas and air for burning the gas, which results in a blue flame.

The Air and Our Bodies

10. The evaporation of perspiration from our skins absorbs a great deal of heat from the body. Now this evaporation will be rapid if the air does not contain much moisture (clear day). The rapid evaporation cools our bodies, which then function normally and vigorously. But if the day is damp and muggy, the air already contains so much moisture that very little more can evaporate from our skins into it. This leaves us warm and uncomfortable.

If Fire Came—How Long Would Your Building Last?

Uncle Sam Measures Resistance of Beams in a White-Hot Furnace and Discovers Concrete Is Best Fireproofing Material

DO you know that in a burning building wooden beams will resist fire longer than unprotected steel columns, when under full working load?

Do you know that concrete is the best all-round fireproofing material?

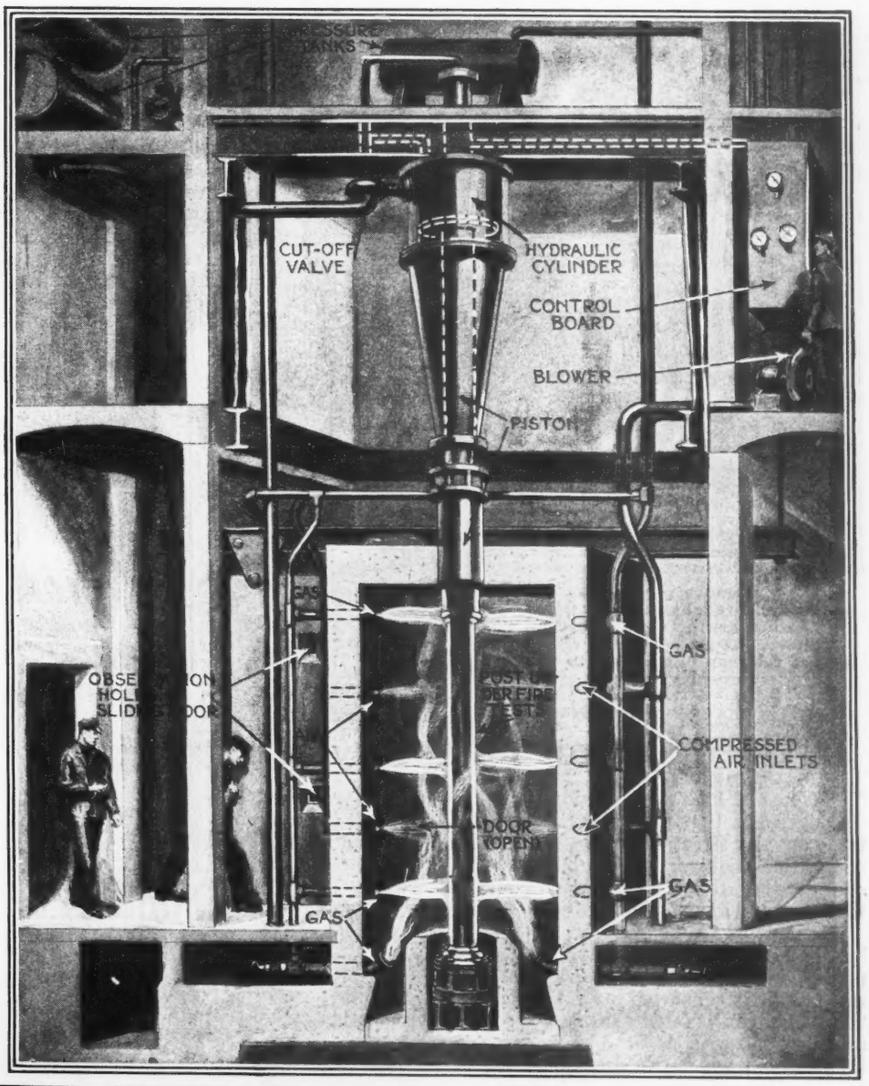
Uncle Sam has supplied these and many other illuminating facts that will help cut down the nation's annual half billion dollar fire bill, through a series of severe fire and water tests applied recently to 106 different kinds of building columns. The immediate purpose of the investigation, conducted by the United States Bureau of Standards, was to secure scientific data as a basis for municipal building codes throughout the country.

The conditions that would exist in a burning building were reproduced as accurately as possible in the tests. Each 12-foot column was placed in a furnace and slowly heated to a maximum of 2300° F., while a hydraulic ram applied to the top of the column a working load or pressure of 100,000 pounds.

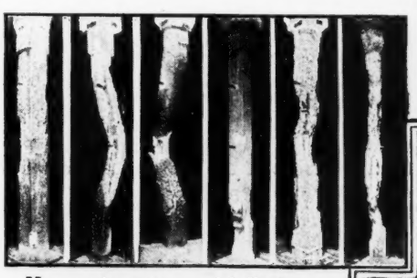
Pyrometers and deformeters measured the temperatures and the manner in which the columns became distorted under the combination of heat and pressure. If the column still remained undamaged after an hour, a stream of water was turned on it while it was still at white heat.

Tests were made on unprotected steel, cast iron, concrete-filled pipe, and timber columns, and also on columns where the metal was partially or completely covered by concrete, hollow tile, brick, gypsum block, and single or double layers of metal lath and plaster.

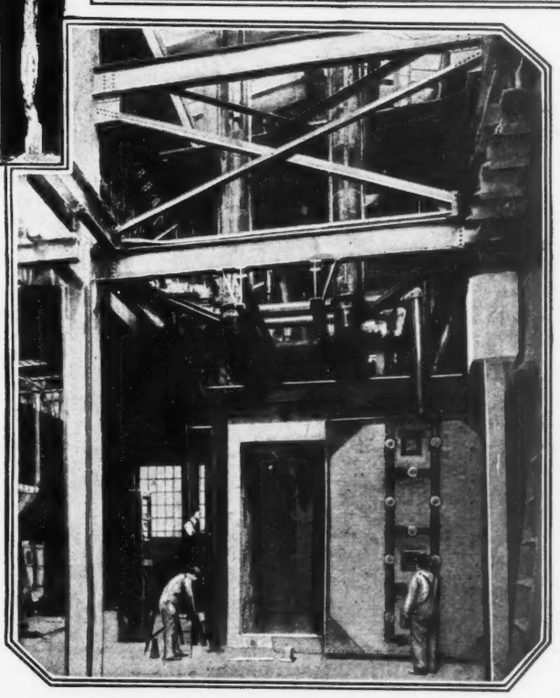
The furnace and accessory equipment used were specially designed. The main ram was 36 inches in diameter, and was



While the furnace flames baked the building column a hydraulic ram applied 100,000 pounds pressure, as shown in the cut-away view above. The photograph at the left shows the observer watching the effect of the flames through a window in the furnace wall



How various types of full-size concrete-protected columns came through the terrific heat tests is illustrated above



connected with a smaller lifting ram. Water maintained at the required pressure of 100,000 pounds by an air compressor was the operating medium. Two stationary and two movable brick walls suspended in structural steel frames from overhead beams comprised the furnace walls. These walls were provided with mica-glazed observation holes through which all parts of the column could be observed during the test. Four primary blast burners heated the furnace.

From the moment the gas flames were turned on until the point of failure, temperature and deformation measurements were recorded. These measurements showed that concrete covering was the best fire resistant because it both insulated the metal beam against heat and helped to carry a portion of the load. As the fire started, the beam first expanded until it bore the entire weight. Before long, however, the metal, softened by the rising temperature, was compressed by the hydraulic ram until a constantly increasing portion of the load was borne by the covering.

The resistance of unprotected wooden beams was extraordinary. They usually held out for 25 minutes. This record equals that of a cast iron column or pipe filled with concrete capable of bearing the same load, and far exceeds the fire resistance of structural steel, which failed within 10 minutes after heat was applied.

© Courtesy Boston *Post*

High pressure pumps enabled Boston firefighters to lay down the barrage of water pictured above. At the right, fire chiefs are telegraphing orders to the pumping station

Firemen Control Pumps by Wire

THE use of high pressure pumps which recently made possible a demonstration water barrage 125 feet high and extending entirely across a street in Boston, Mass., has necessitated the adoption of a telegraphic signal system by which the chiefs of the firefighters can communicate with the pumping engineer.

Three double pumping units have been installed in different parts of the city, each propelled by a 750-horsepower electric motor directly connected to a rotary pump. These units can be worked singly or together in accordance with the need at the scene of the fire; but where two fires break out at the same time, the two fire chiefs in charge must be able to communicate and to issue uniform orders to the engineers at the pumps.

It may be necessary to change the pressure under which water is delivered, or to double the volume supplied to one fire.

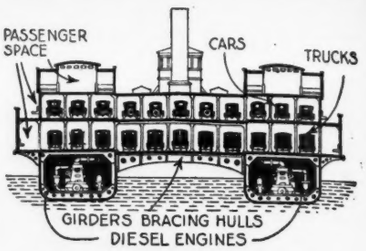
Telegraph at Alarm Box

For this purpose the telegraph has been adopted as more reliable than the telephone, and a special wire circuit is carried to fire headquarters from each alarm box. The chief's chauffeurs are experts in telegraphy, and each carries a portable Morse sounder and key and a microphone set, which he plugs in at the box. A telephone is also provided for minor questions and answers of which it is not necessary to keep a permanent record. To prevent conflict of orders the firefighters communicate with the central office, which in turn relays the orders to the engineer. This system assures an adequate supply of water at both fires.

One pumping unit can supply 12 hose lines with 4800 gallons of water a minute. This is the volume of water which would be carried by a brook four feet wide and a foot deep flowing as fast as a man walks.

Mammoth Ferry Designed like Bridge

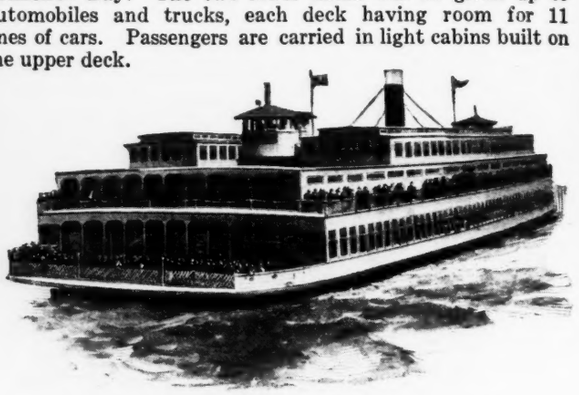
FERRIES designed for use between Oakland and San Francisco, California, offer a novel feature in hull construction, for in cross section they are built like a bridge, with arched steel girders connecting twin hulls. Essentially, this is the principle of the primitive catamaran, but because of the wide, flat deck on top of the connecting bridge, the boats will be able to carry more automobiles and passengers than has ever been possible with the familiar type of ferry, now overburdened with traffic.



Twin hulls supporting two vehicle decks and one passenger deck are planned for the super-ferry

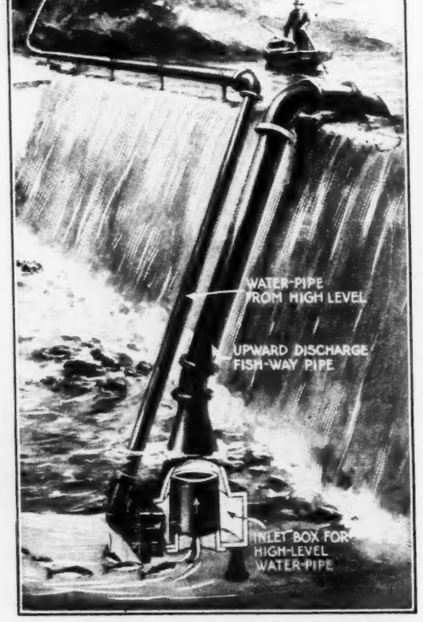
As it was not desired to pierce the hull by a smokestack, Diesel engines were adopted. One engine is placed in each hull, with an electric signal system centering in the pilot house, by which the pilot can transmit orders to both engine rooms. Each hull has its own bow and stern rudder, and as the distance between the propellers and the center line is unusually great, the boat can be maneuvered readily by the engines alone.

These innovations permit ferries of mammoth size which can handle easily the constantly increasing traffic across San Francisco Bay. The two lower decks will be given up to automobiles and trucks, each deck having room for 11 lines of cars. Passengers are carried in light cabins built on the upper deck.



Eleven long driveways for vehicles on each deck provide vast traffic accommodations, as shown above

Fish to Climb Dam in a Suction Tube



The flow of water creates a suction that lifts the fish up the tube

DURING their running season schools of fish pass upstream to spawn, and usually some sort of fishway must be provided to permit them to pass dams and other obstructions. One such scheme that is somewhat out of the ordinary has been invented by E. S. Howard, of California.

His invention consists of a tube leading from the front of the dam up and over to the water on the other side. Connected with the bottom end of this tube is another pipe which runs to a source of water under pressure. The under side of the bottom end of the conveyor tube is open to allow the fish entrance.

When water is allowed to flow from a high level under pressure down to the conveyor tube, it creates a suction at the lower end. This suction draws the fish that surround the tube and lifts them up the conveyor tube to the top of the dam, where they are dumped into the water.

THE normal adult can hold his breath from 40 to 45 seconds, but this time can be increased considerably by training, as in the case of divers.

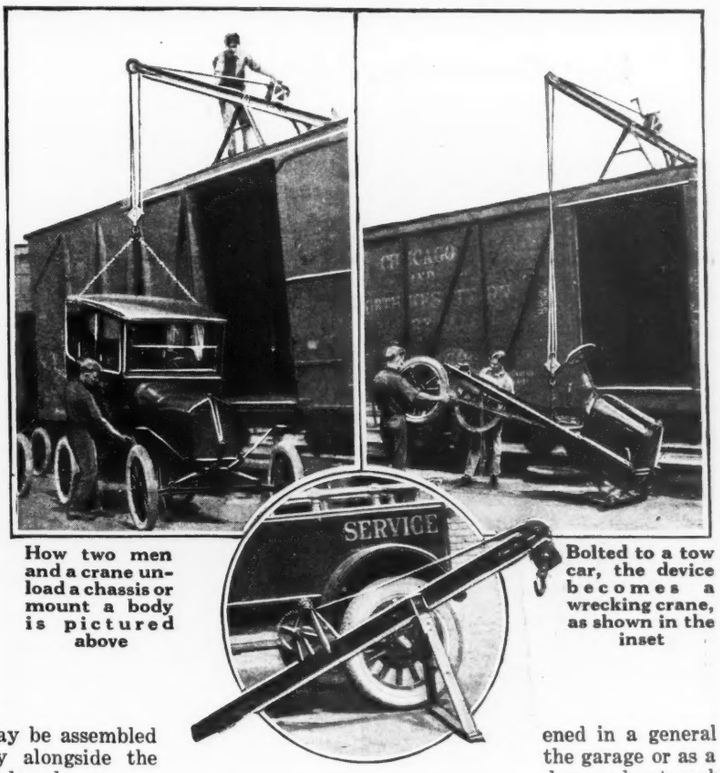
An individual's breath-holding capacity is affected so markedly by disease of the heart or air passages that it is used in France as a means of diagnosis for bronchitis or tuberculosis. It is a well-known fact that sufferers from these diseases can rarely hold their breath more than 20 seconds.

Portable Crane Will Speed Delivery of Your New Car

ANY automobile dealer who has had his troubles unloading machines, particularly sedans, from box cars, will appreciate the advantages of a newly invented winch with which two men can unload a dozen chasses and mount two bodies in an hour without damaging them.

The rush and worry to assemble and deliver a new car on time—the grappling with it in the freight yards, the damaging scratches to the polished body—these troubles are relieved by the new portable apparatus. It consists of a steel I-beam about 10 feet long, supported on a tripod placed on the roof over the freight car door, and held in place by a steel chain that passes down the other side of the car and is fastened to the floor beams.

By means of the compact, powerful winch one man can raise and lower a body, and even control it so exactly that the automobile may be assembled in the freight yard directly alongside the tracks. No trucks or wooden horses are needed, since the chassis can be suspended in the correct position for putting on the wheels.



How two men and a crane unload a chassis or mount a body is pictured above

Bolted to a tow car, the device becomes a wrecking crane, as shown in the inset

Ordinarily eight men form the crew for unloading automobiles from freight cars. Even then, considerable heavy lifting is required, and there is always the risk that one of the crew will weaken or slip and the body be dropped to the ground. The reduction of the crew and the elimination of the heavy manual labor naturally results in quicker work and less damage to the car. Small as it may seem, the bills dealers must pay for refinishing bodies scratched by the unloading crews are said to run into large amounts annually.

The fact that automobiles may be assembled in the yard reduces, also, the trucking in connection with delivery. When there is no unloading to be done, the beam and the winch may be mounted on rollers or fastened in a general utility truck and used about the garage or as a wrecking crane to bring home damaged automobiles.

From Sawdust and Ashes to Fancy Candy Boxes!

FANCY candy boxes made from sawdust and ashes, shaped and modelled in delicate artistic forms by a single impress from a stamping machine promise a new use for these waste materials. Instead of being built up by four or five separate operations, each box is completed from the plastic raw material by one blow of the die.

The finished material, resembling rye bread in color and structure, is stronger and more easily worked than common cardboard. The candy boxes are decorated with an ivory finish paint, though indeed the new substance lends itself to any treatment. It can be painted, covered with cloth, and even gilded or silvered with genuine metals.

In making the boxes, finely divided coal ash and sawdust are mixed, and a certain amount of sticky binder of a secret chemical formula is added. The proportions vary according to the qualities desired in the final product. The inventor claims the material can be manufactured as flexible as cardboard or as tough as metal, and either waterproof or porous.

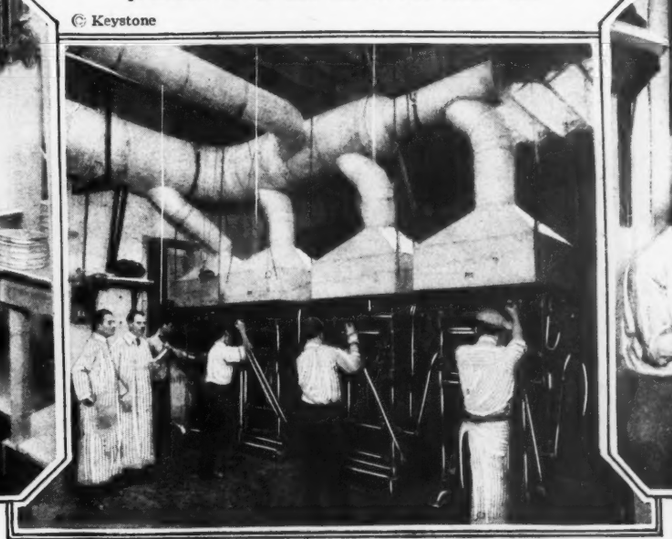
Stamping is done with heated dies; and since the article comes out of the press dry, no drying room is necessary. The heat of the press acts on the chemicals of the binder, which combine with the sawdust into a hard, semi-porous material. The presence of the ash can be felt before the boxes are painted, but cannot be seen. The ash is added as an inert filler, it is believed, to cheapen the cost of the raw material and to make the completed boxes better able to take paint or glue.

Since the material is plastic when it goes into the presses, the engraved and embossed dies can turn out modelled boxes, even of intricate design.

After leaving the presses, the marks of the stamping machine are trimmed off on an emery wheel, the boxes are painted with an air-brush, and then are ready for market. The cost of the raw material for these boxes is said to range between a cent and a half and five cents a pound.

© Keystone

Here the rough edges of the boxes are being smoothed out by a rotary emery wheel



Finely ground powder of ashes and sawdust, mixed with binder, is stamped into artistic forms in the presses illustrated above

From ashes to boxes! Here is the remarkable product coming from the pressing machine

Do You Know How You Laugh, Cry, Sneeze, Cough, and Snore?

IT is almost impossible to fake a laugh or a cry so naturally that any one will be deceived. The ear instantly detects a false note. Even the most skilful actors and singers never quite succeed.

The difficulty lies in the fact that laughing and crying are naturally produced largely by the involuntary muscles, and because all forms of "abnormal respiration," as they are called, are much more complicated operations than is generally supposed.

When You Laugh

A laugh, for example, is produced by holding the vocal cords tense and producing a clear resounding note by forcing a series of short expiratory blasts against them. A hearty laugh may include as well the vibration of the larynx and pharynx.

In crying, you partially close the glottis, the slitlike opening into the larynx, and take a short deep inspiration and a prolonged expiration. If the crying lasts long enough, there is a sudden spasmodic contraction of the diaphragm resulting in the abrupt inspiration and expiration sounds in the larynx and pharynx, familiarly known as sobbing.

To cough, one first takes a deep breath, then partially closes the glottis, and directs against it a violent expiratory blast which forces the glottis open and expels any mucus or other irritating matter accumulated in the air passages.

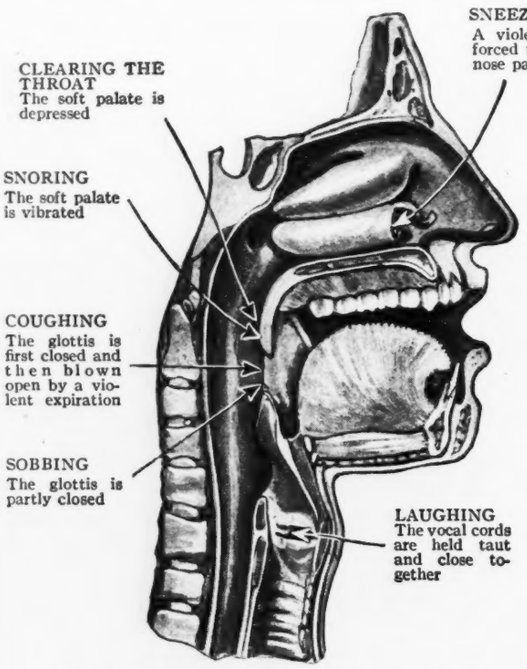
In clearing the throat a current of air is driven from the lungs and forced between the narrow space between the root of the tongue and the depressed soft palate.

A sneeze consists of an inspiration, often very rapid, and then a sudden blast directed through the nose. The glottis remains open throughout the operation.

In snoring, an unusually steady and prolonged inspiration and expiration is set going through the open mouth until the soft palate and uvula are set in motion by the vibration of the air currents.

A hiccough is an inspiration due to a spasmodic contraction of the diaphragm suddenly checked by closing the glottis.

How "Involuntary" Actions Happen


SNEEZING
A violent blast is forced through the nose passage
CLEARING THE THROAT
The soft palate is depressed
SNORING
The soft palate is vibrated
COUGHING
The glottis is first closed and then blown open by a violent expiration
SOBBING
The glottis is partly closed
LAUGHING
The vocal cords are held taut and close together

The locations of the organs involved in producing various complicated muscular acts, such as laughing, crying, and sneezing, are shown in the above cross-sectional diagram

Imitations Difficult

In every case the sound is caused by a complicated series of interactions between groups of muscles at different points along the respiratory system, only a few of which we are able to control at will. For this reason our polite laughs sound forced.

The difficulty of convincingly imitating crying, either as an expression of sorrow or joy, is complicated by the fact that the purely muscular act of crying is accompanied by a sympathetic excitation of the tear glands, causing tears to fall.

Are X-Rays Outclassed by Powerful New "Odic Ray"?

DISCOVERY of "odic rays" of high penetration produced simply by the electric current drawn from an ordinary light socket, and yet with the curative and medicinal value of X-rays, is claimed by Dr. Edgar L. Hollingshead, of Pasadena, Calif.

With simple, inexpensive apparatus he is reported to have passed rays through 11½ inches of lead and 4½ inches of steel, at such strength as to sear dental X-ray films encased in tinfoil.

Such an achievement appears impossible; yet X-rays seemed equally impossible when Röntgen first announced their discovery. Doctor Hollingshead's claims are based on tests made in the presence of eyewitnesses who selected at random the films exposed to the rays, retained the duplicates, and developed the two simultaneously in the presence of an unprejudiced committee. After exposure, these films were found to be perceptibly darkened.

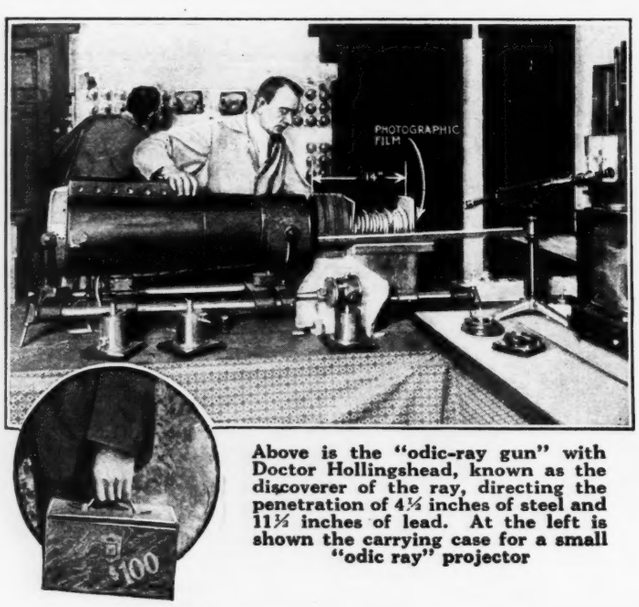
Doctor Hollingshead declares that the rays produced by his apparatus are of greater intensity and penetration than any previously known to science. The rate of vibration of the "odic rays" can be controlled by the operator, it is asserted.

If these claims are substantiated, the value of the discovery to the world will be enormous. The medical profession will have an unlimited supply of curative rays. The X-ray diagnosis can be utilized by every doctor in the country, since the apparatus can readily be carried from house to house.

The doctor has given a partial explanation of his ray.

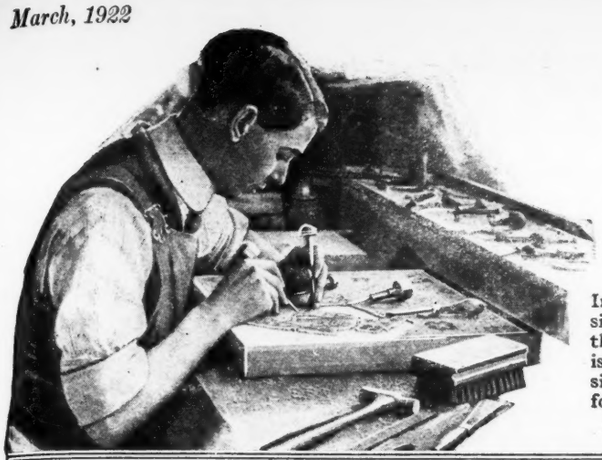
He has found, he says, that electricity is not simply a force, but a substance. Amperage, he adds, is the substance part of electricity and voltage the speed. Like any other substance, electricity is composed of vibrating molecules, atoms, electrons, and other infinitesimal units, and the form that the substance takes is due to the rates of atomic speed.

The only differences between one ray of light and another are in wave lengths or vibration, speed of discharge, and polarity. Assuming that electricity is like water flowing through a pipe, and that its voltage is the speed with which it travels, he first intensifies its atomic speed, then he breaks it up, releasing a force or ray of great speed and power.



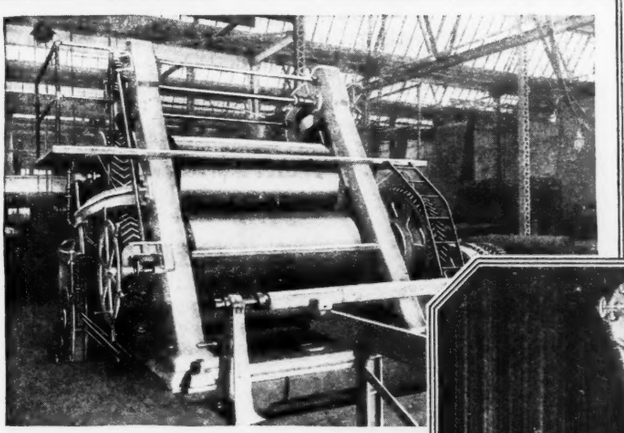
Above is the "odic-ray gun" with Doctor Hollingshead, known as the discoverer of the ray, directing the penetration of 4½ inches of steel and 11½ inches of lead. At the left is shown the carrying case for a small "odic ray" projector

How Machines Make Magic Carpets from Oil and Cork

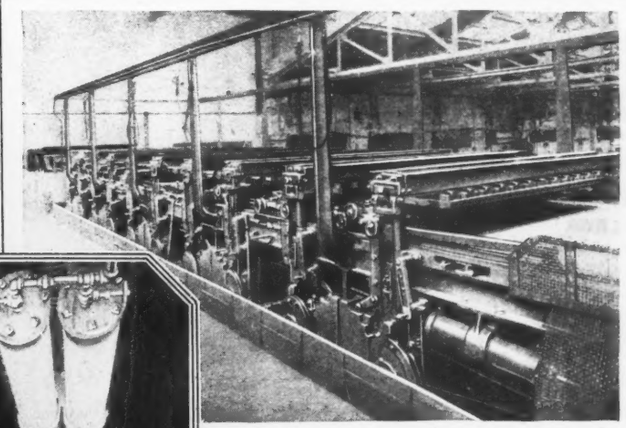


In the color-design department this block-cutter is carving designs or "cuts" for printing linoleum carpet

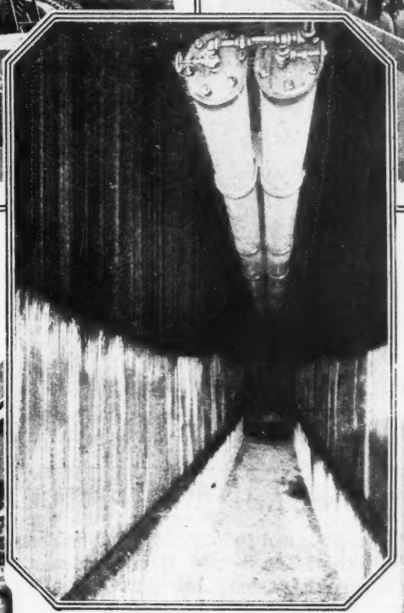
A HALF a century ago a young inventor noticed that the film on a can of paint was tough. He exposed linseed oil to the air, oxidizing it, then mixed in cork and gum, and produced a substance that could be rolled out, like a pie-crust, into a carpet. Today linoleum, which he thus originated, is manufactured by the machinery pictured on this page.



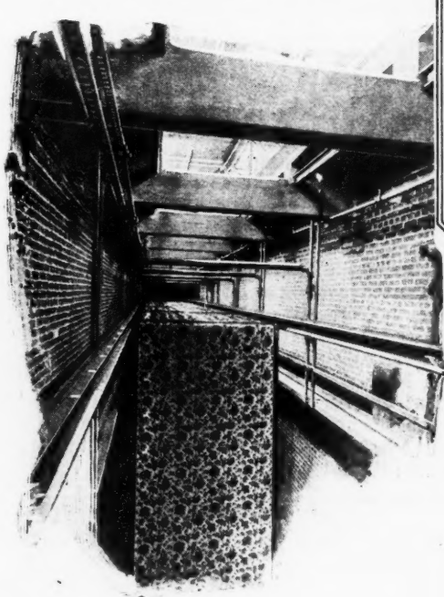
Heated rollers weighing 26 tons each, press into burlap a cement composition of oxidized linseed oil, cork, and gum, forming a waterproof floor-covering. Above is shown one of the presses



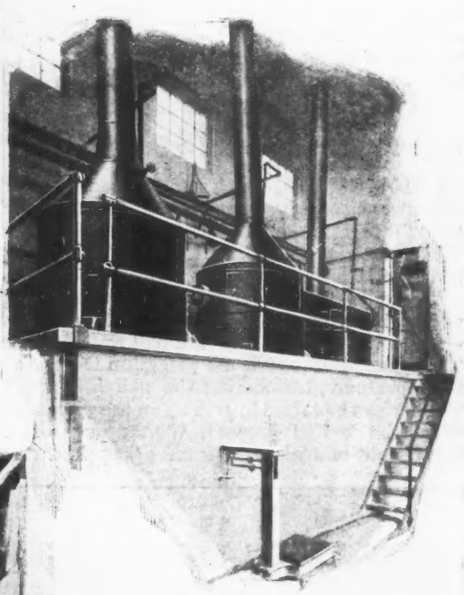
Operated on a track, so that they can be moved from one end of the building to another, the printing-presses shown in the photograph above stamp color designs on wide sheets of linoleum



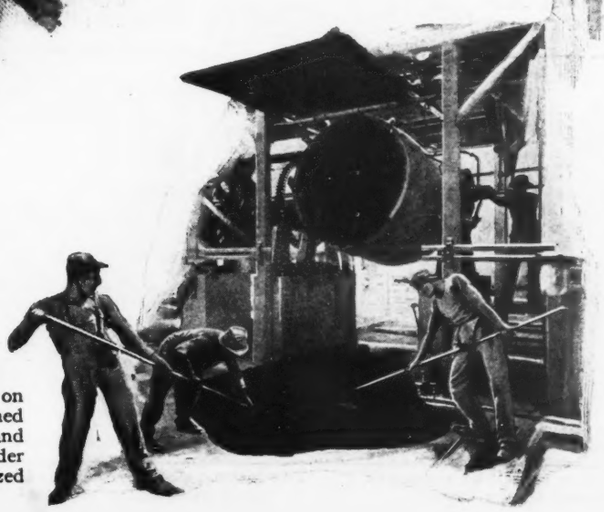
Here in the oxidizing sheds, boiled linseed oil drips from a conveyor to sheets of scrim that hang from the ceiling. Heat and oxygen turn the oil into semi-solid form



Fresh from the printing-press, the sheet of linoleum is hung in loops to dry in a chamber or "stove" heated to 100 degrees. Above is a top view of the "stove"



Above are three of the vats in which linseed oil, one of the principal ingredients of linoleum, is boiled. From the vats the oil is pumped to the oxidizing sheds



The semi-solid linseed oil on the oxidizing sheets is mashed and mixed with rosin and gum into a cement or binder that will hold the pulverized cork together

A pile of linoleum cement just after it has been poured from a vat for cooling may be seen in the photograph at the left. When dry, the cement looks like marshmallow

© Mirzaoff

Motor Ambulance Carries First Aid to Injured Dogs

DOGS injured by autos on the roads near London, England, now are cared for by a motor ambulance. A veterinary gives first aid on the spot, and if there is hope of saving the life of the pet, it is placed on a thick bed of straw and carried to a kennel for further treatment.

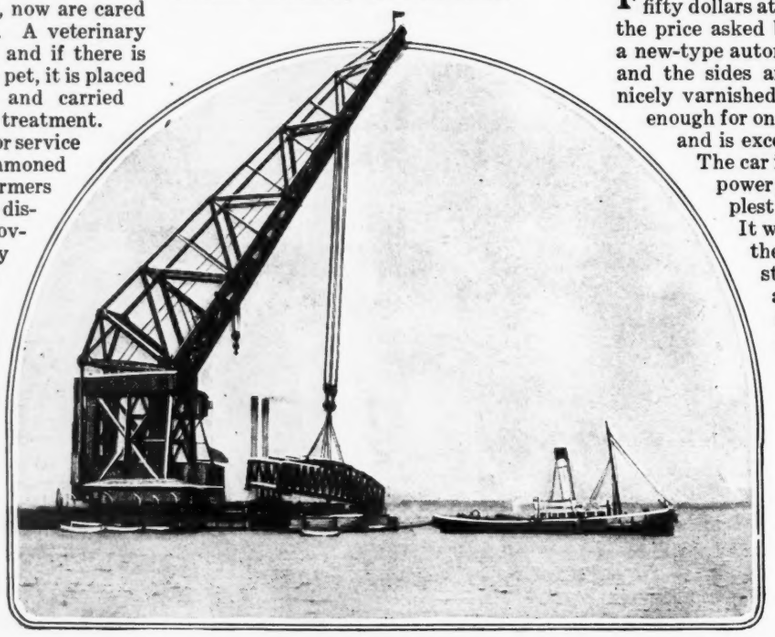
The ambulance is ready for service day and night, and is summoned by telephone. All the farmers living near the roads in the district outside of London covered by this service notify headquarters as soon as they are aware that an accident has taken place, and the cyclecar immediately starts.

XILITE, a new insulation material, is being produced in Venice. It is a resinous compound manufactured synthetically and has been found to be particularly well suited as a substitute for wood in tool handles. Button-makers are also using it in place of better known bone and shells.

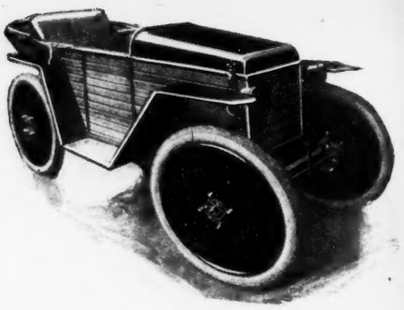
Floating Crane Handles 150 Ton Bridge Like Plaything

A 150-TON bridge was a light load for the mammoth floating crane belonging to an English shipyard on the Mersey River. The bridge was picked bodily from its abutments, placed on a barge, and towed down the river to Seacombe for repairs. This is believed to be one of the heaviest weights ever lifted by a floating crane. The bridge was raised with the second tackle and run out well toward the top of the crane arm. Had it been necessary the crane could have lifted the heavy bridge 75 feet into the air.

These floating cranes are ordinarily used to place in position the engines and other internal machinery of ocean liners.



The floating shipyard crane picked up the entire bridge span weighing 150 tons, swung it around and placed it in position on a barge



Cyclecar Sells Complete for Fifty Dollars

FIVE thousand marks—approximately fifty dollars at present exchange rates—is the price asked by its German makers for a new-type automobile. The car isn't big, and the sides are made of wooden slats, nicely varnished; but for all that it is big enough for one person, has a real engine, and is exceedingly light weight.

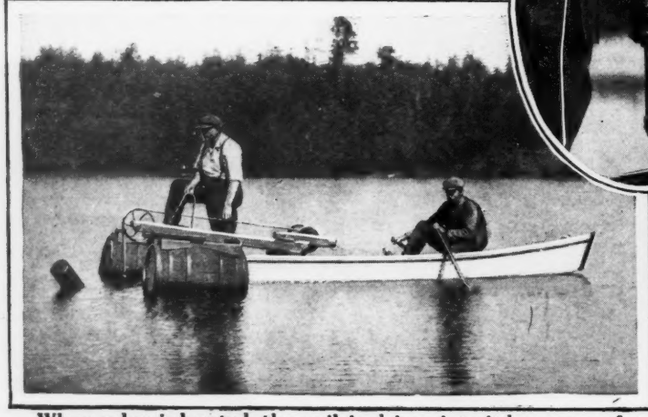
The car is practically a motorcycle power engine installed in the simplest possible automobile body. It will be noticed, however, that the usual features of auto construction are present, and axles, steering knuckles, springs, are similar to those of the larger cars except for size. The ridiculously low price includes headlights and horn.

ONLY two out of every thousand automobile accidents are really unavoidable, according to a survey conducted by the Auto Club of southern California. Twenty-five per cent of all the accidents are caused by carelessness.

Logs Hauled from Lake Bottom with Line and Nail

A HOMEMADE "hook and line" salvaging outfit, attached to a rowboat, has fished thousands of dollars' worth of "deadhead" logs from the bottom of a small lake in northern Wisconsin. The essential part of the fishing tackle is a tenpenny nail, which is driven into a log by a hammer operated from the boat.

The nail is clamped in the end of an iron rod to which a sliding weight is attached, and the whole outfit is lowered into the water until the point of the nail rests on a sunken log. Then the operator pulls the weight up the rod and lets it fall repeatedly, hammering the nail into the wood. The log can be raised by pulling on the wire cable by which the device is lowered. When near the surface it is caught in a wire noose and dragged ashore.



When a log is located, the nail is driven into it by means of the string and sliding weight shown in the insert

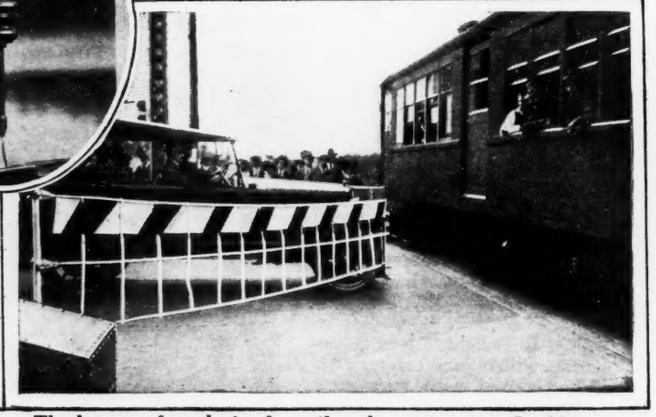
Wire Net at Grade Crossing Stops Reckless Motorists

FLEXIBLE safety gates of wire rope, which fall as a train enters the nearest electric block, have been installed to guard several bridges and grade crossings in Chicago, and so prevent the foolhardy motorist from risking his life at these points. Even if the gates are struck by an auto traveling at high speed, the ropes will hold and prevent the car from getting on the tracks.

Enough slack is left in the network so that the gate will give before any shock and check the moving vehicle gradually.

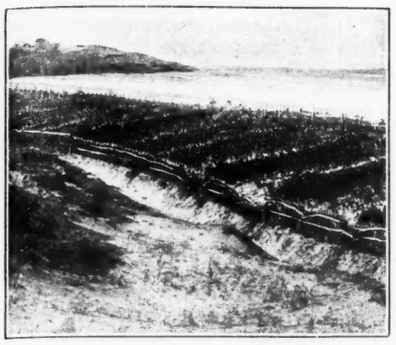
More than 1500 persons were killed and nearly three times that number were seriously injured in grade-crossing accidents during the past year, according to railroad statistics. The new safety gates represent an attempt to reduce this toll.

© U. & U.



The latest safety device for railroad crossings is a flexible gate that will stop an automobile traveling at high speed

IS there something on this page that arouses your curiosity? Write and ask about it. Our Service Department will be glad to answer your inquiries.

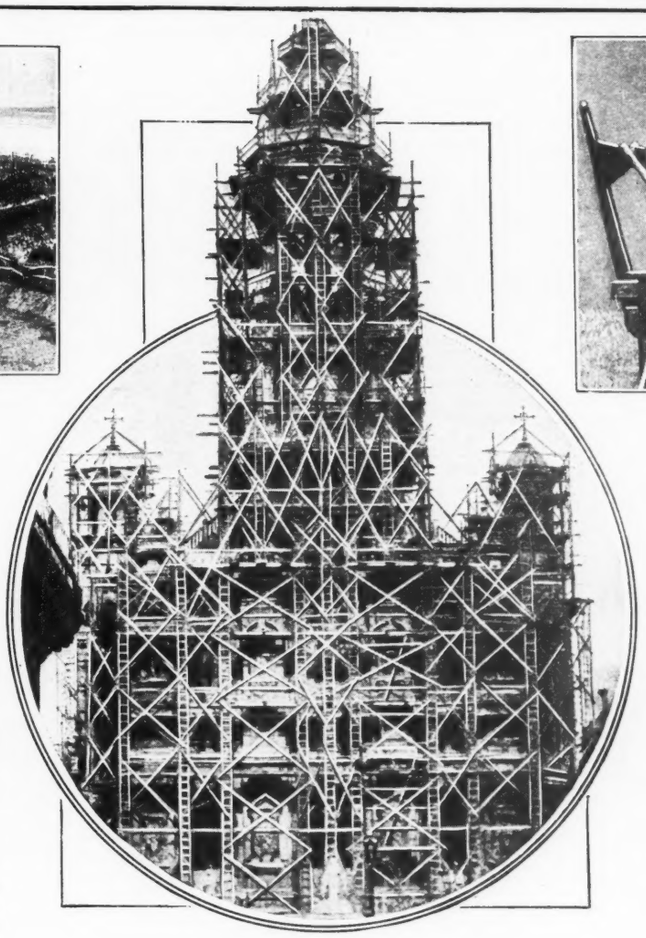


Grapes Flourish on Sand Dunes

ONE of the most unusual vineyards in France, perhaps in the whole world, is found in Anglet, on the Mediterranean. The grapes are grown on the sand-dunes a few feet from the seashore. Many attempts were made to utilize the immense wastes of the seashore, but without avail. About ten years ago M. Dumail experimented by planting young grape-vines upon a piece of property which he acquired gratis, near the famous lighthouse of Biarritz.

The main difficulty of planting grape-vines by the seashore is the winter storms and winds that blow off the sea toward the land, shifting the sand from one place to another. To prevent his vine stock from being uprooted by the winter gales, M. Dumail erected high fences and behind them planted branches from tamarind trees. These took root, and grew into a solid wall, impenetrable to sand.

THE arid deserts of Western Australia are being irrigated by artesian wells.



Scaffolding Veils French Church

UNABLE to swing scaffolds on ropes from the towers and roof, because of the statuary, carvings, and grillwork cut in the stone, masons working on the historic church of the Trinity in Paris covered the entire building with scaffolding before pointing up the masonry.

The stonework had deteriorated to such an extent that the church practically had to be rebuilt. Wherever possible, the outer stone facings were removed and replaced by new stone cut from the same quarry.

How to Dance Out the Week's Wash

GRACEFUL dancing is easy for any one who will practice assiduously—with a washing machine. Such, at least, is the advice of Clifford G. Sweet, of San Diego, Calif., a teacher of dancing, who has invented a washing machine with which the housewife can perfect herself in the terpsichorean art without interfering with household duties.

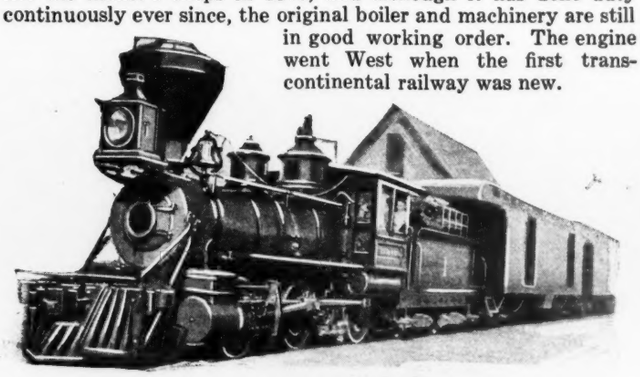
The machine has long, upright levers pivoted to bars that extend under the bench on which the tub rests. On the upper portion of the levers are bracket arms carrying the suction plungers used in washing machines.

The levers, spaced well apart, are connected and move simultaneously—and here's where the dancing practice comes in. By grasping a lever in each hand and swinging from side to side, bending first one knee and then the other, the pupil not only washes the clothes but practices a fundamental dancing movement. When one knee is bent, the other leg of the pupil remains straight, with the toe pointed.

"Old Timer" Still Puffs and Pulls

FORTY-SIX years of hauling trains have not worn out a locomotive still in service on the Lake Tahoe Railway in California. The old timer continues to operate today as evidence of the durability of American-made machines.

The locomotive was the latest thing in engine building when it left the maker's shops in 1875, and although it has done duty continuously ever since, the original boiler and machinery are still in good working order. The engine went West when the first transcontinental railway was new.



Will the locomotives of to-day last as long as this one? After 46 years of active service, it is still hauling trains in California

Strange Walls Guard Tibetan Valleys

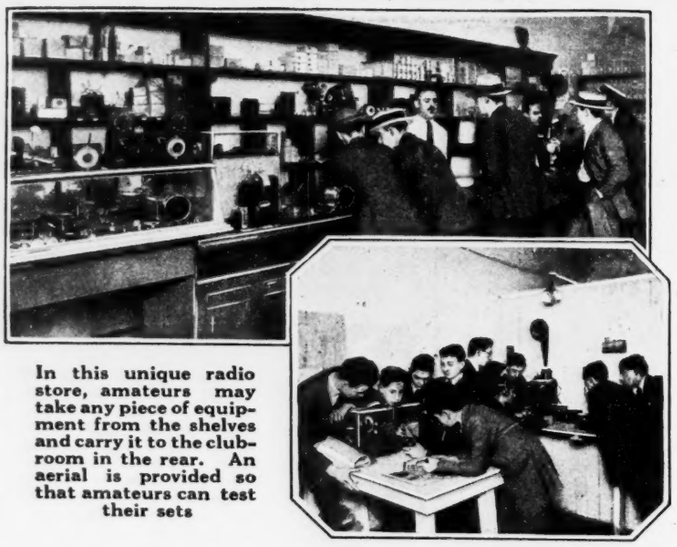
THE explorers who attempted to scale Mount Everest discovered, among other things, several ancient fortifications built in unexpected places in the high Tibetan mountain valleys, 15,000 feet above sea level.

Partly to protect the fields from being washed away by mountain freshets and partly to guard against raids by enemy tribes, walls 20 feet high and often more than a mile long, guarded by strange round watch towers, were constructed at intervals at the head of these fertile valleys.

Mount Everest explorers discovered this stone wall and watch tower in high Tibet, where it has stood for more than a thousand years

Radio Store Provides Free Clubroom for Wireless Amateurs

IN the back of a retail electrical store located in the skyscraper section of New York City, there is a unique clubroom for radio amateurs. A full set of radio receiving equipment has been installed with an aerial on the roof. Apparatus can be tested out in actual practice, and the visiting amateur is given the privilege of taking any piece of apparatus from stock to connect up and use as he sees fit. The employees of the store make no attempt whatever to sell goods to the amateurs using the clubroom. Even if the visitor asks for information, it is given without any intimation that he is expected to buy.



In this unique radio store, amateurs may take any piece of equipment from the shelves and carry it to the clubroom in the rear. An aerial is provided so that amateurs can test their sets

Amateurs who live many miles apart and who know each other only *via* wireless, form a habit of dropping into the club and talking over their installations. If one has a new idea in hook-ups, there is a chance to test it out. If a newcomer wishes to learn the standard connections, there are blueprints on the walls. If a "club member" has a theory of radio to demonstrate, he can step to the blackboard and sketch it out with the other amateurs present giving criticism and argument. Sometimes, if one is lucky, one may meet some of the experts from the big wireless companies, and get the latest "dope" direct.

By promoting interest in radio, the clubroom has proved a moneymaker for the store. The goods sell themselves, for by listening to the conversations in the clubroom the beginner in wireless finds out what he needs for a first class station, and goes out into the store and buys it. He has learned the right name, too, and does not waste the clerks' time nor compel the salesman to give a curtain lecture on electricity and magnetism every time a receiver is sold. Best of all, the clubroom gives the amateurs a chance to exchange ideas and stimulates their interest in radio.

Linemen Use Portable Floodlights at Night

LINEMEN of an electric-light company in Detroit use an old truck for an emergency lighting equipment for night repairs. A complete generating set consisting of a direct-current, 120-volt dynamo, directly connected with an air-cooled engine, of one-kilowatt capacity, is mounted on the vehicle.

Floodlights with 15-inch reflectors and 250-watt lamps illuminate the scene of the repair. When the doors of the body are locked, these lights are secured in clips in their compartments, insuring their readiness for service when the job is reached. The reel for the wire used carries 3800 feet of twin conductor.

IN England, chalk, blended with a rich carbonaceous material, the basis of which is coal-tar, and molded in briquettes, is being used as a fuel substitute.

It is reported that the fuel gives out greater heat than coal, burns more evenly and for a longer time, and produces a minimum of ash. The chalk is employed to conserve the heat and make the fuel more lasting.

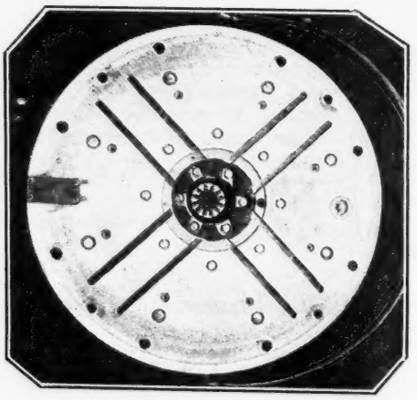
Machine Cuts Whole Gear at One Time

DIFFERING from other types in that it cuts all the teeth in a gear at one time, a multiple gear-cutting machine has been developed by an Indiana manufacturer.

The machine operates much like a vertical shaper, except that the tools are held stationary and the gear blank is reciprocated past them. The mechanism consists of a ram carrying a blank supporting arbor and the multiple tooled head. In position, the machine is seven feet in height, and weighs 17,000 pounds. When operating at full capacity, it is driven by a 100-horsepower motor.

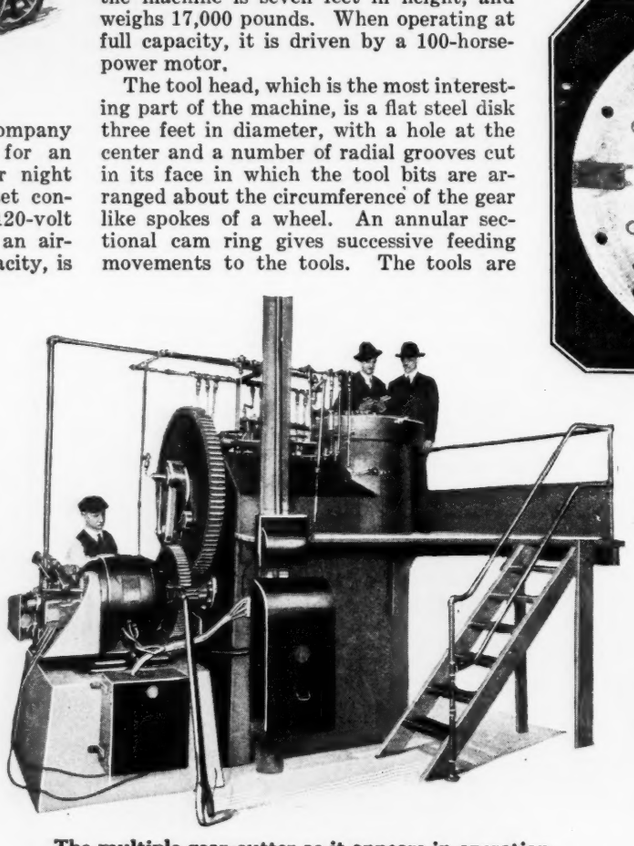
The tool head, which is the most interesting part of the machine, is a flat steel disk three feet in diameter, with a hole at the center and a number of radial grooves cut in its face in which the tool bits are arranged about the circumference of the gear like spokes of a wheel. An annular sectional cam ring gives successive feeding movements to the tools. The tools are gradually fed in by successive cuts of the tooth.

At the completion of each stroke of the ram and before the next cut begins, the gear blank is indexed a space equal to one tooth, thereby presenting a different tool to each tooth from the one that made the previous cut. After the tools have been fed in to full depth, they are held stationary in that position while the cutting process continues until the gear has indexed one complete revolution and thus each tool takes one last cut on each tooth.



The cutter head, showing the radial grooves in which the tools are arranged

This final complete index insures a uniformity of spacing of the teeth in the gear equal to that of the indexing mechanism. It is claimed that uniformity of the tooth form is secured even when the tools themselves may be far from uniform, because if any tool is longer or wider than any other, even if only by a thousandth of an inch, that projecting portion will take one last cut on the corresponding part of each tooth in the gear.

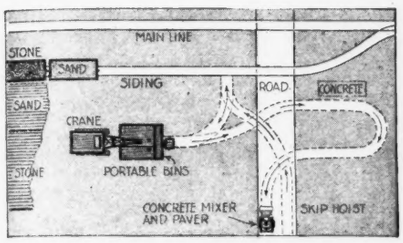


The multiple gear-cutter as it appears in operation. The men on the platform are standing in front of the multi-tooled head

Portable Bin Speeds Up Roadbuilding

INTELLIGENT planning of a material yard and the use of a portable aggregate bin that saved the seconds in loading material recently enabled a crew of 53 green men to lay a mile of 18-foot concrete road in nine working days in the course of a state highway job in Wisconsin.

Nearly two months before the mixer was on the job, all the sand and stone that



How the plant was laid out for rapid paving work is shown above

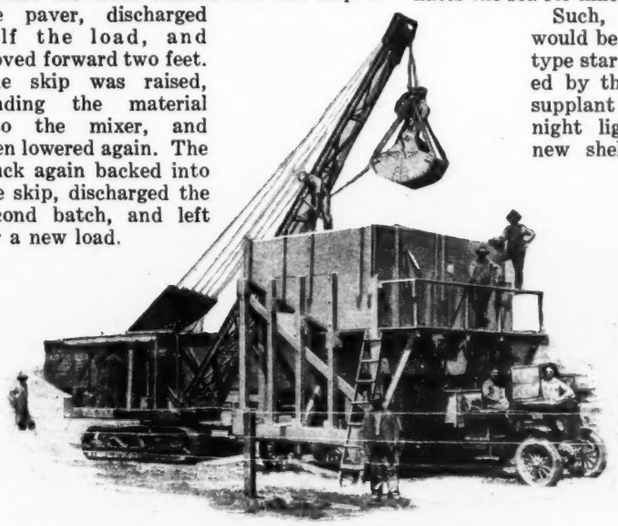
could be obtained was piled in the storage yard. The mechanical equipment here consisted of a crane with a 40-foot boom, which unloaded the sand into a pile about 20 feet wide at the base, and placed the stone in a parallel pile about 50 feet wide.

To obtain the greatest loading speed, a portable aggregate bin was built of white oak, about 14 feet square and 18 feet high, and mounted on road wheels. It was attached to the crane by a rigid 10-foot pole, so that it followed the movements of the crane and made it unnecessary to peak the boom at any time.

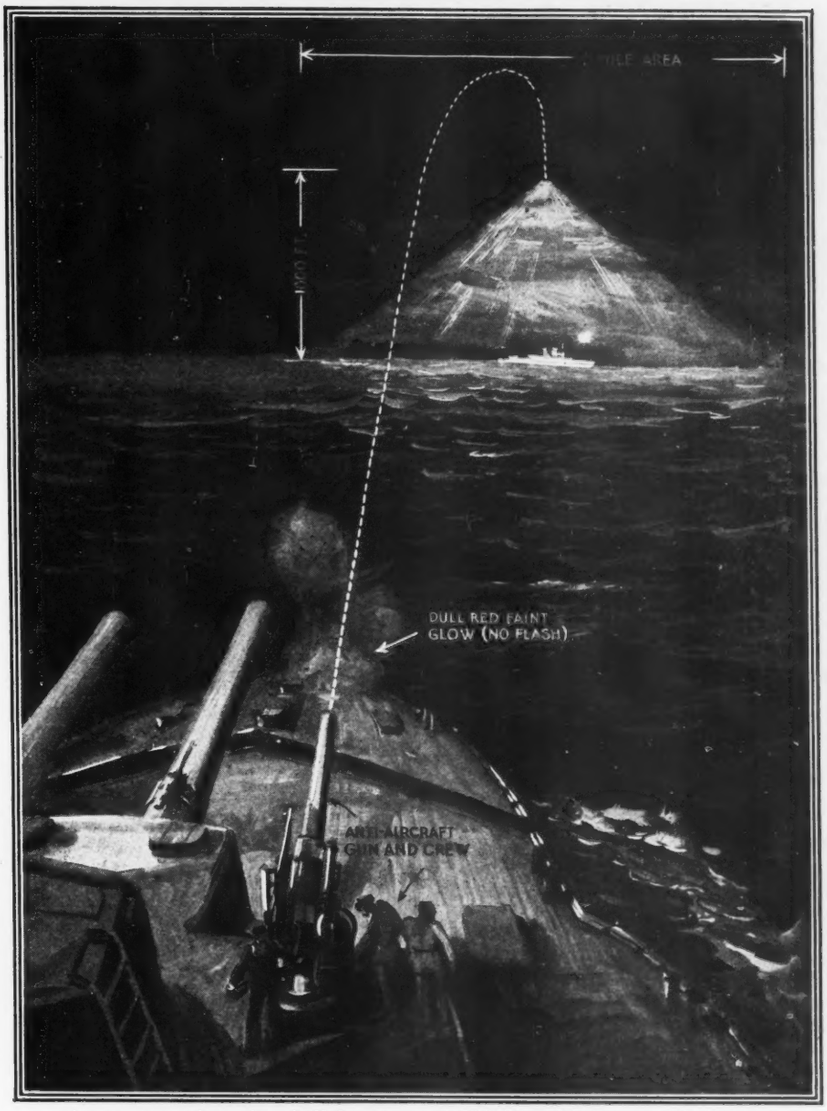
Forty yards of aggregate, 15 yards of sand, and 25 yards of stone were carried in the bin at all times. Two measuring hoppers were mounted below the bin floor, so designed that a mixture of any proportion could be delivered to the trucks by the manipulation of levers, controlled by one man from a platform, that operated the upper and lower cut-off gates.

Each truck after it had backed under the bin and received a carefully measured amount of aggregate in each of its two compartments, drove to the cement shed, where two and a half barrels of cement were dumped on top of the aggregate. Thence it proceeded to the site of the work.

Here the truck backed into the skip of the paver, discharged half the load, and moved forward two feet. The skip was raised, sending the material into the mixer, and then lowered again. The truck again backed into the skip, discharged the second batch, and left for a new load.



Each truck, as it backs under the portable bin, receives an accurately measured amount of aggregate; then drives to the cement shed



A moment after the shell bursts, an 800,000-candlepower light is suspended from a parachute 1000 feet high, illuminating the enemy battleship

Star Shell Replaces Navy Searchlight

A SHELL explodes 1000 feet above an enemy war-ship; immediately the vessel is flooded with dazzling beams from an 800,000-candlepower light that illuminates the sea for miles.

Such, in naval warfare, would be the effect of a special type star shell recently adopted by the American navy to supplant the searchlight for night lighting at sea. The new shell is a development from the trench star shell used during the war. It is fired from a three-, four-, or five-inch gun using a new flashless explosive. The timing fuse of the shell, after detonation, lights a powerful lamp and expels a parachute that keeps the light at a height for a full half minute. The advantage of the star shell is that there is no flash from the gun firing it.

The new shell is loaded into a gun and fired. It has a range of six miles. For the larger guns the shell does not work so well, because of the character of the new explosive; but with the three-inch and smaller guns, it functions almost perfectly.

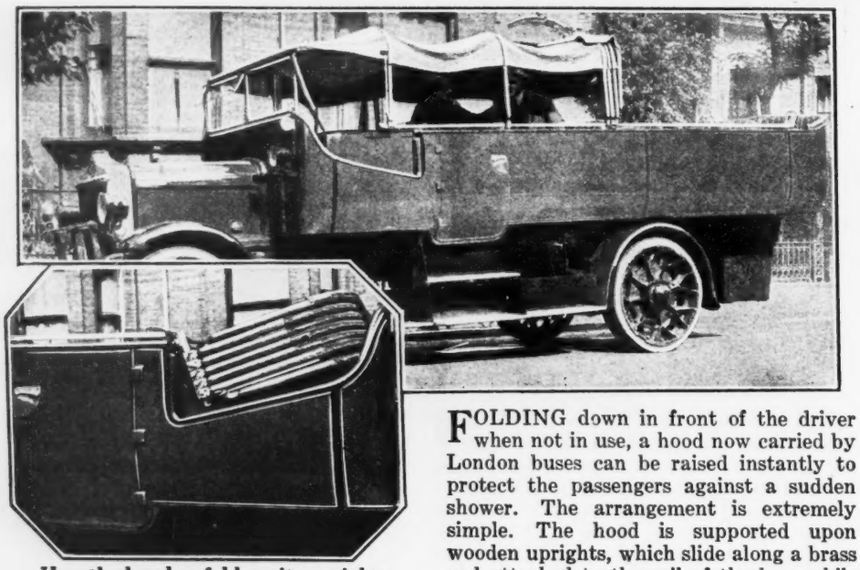
When the shell is fired from the three-inch gun, only a ball of very white smoke issues from the muzzle. This ball of smoke is hardly visible at 500 yards from the ship. With the five-inch gun, however, there is a dull flash that might possibly be recognized by an enemy at long range.

Stained Glass Dies of Disease

GLASS seems to die of disease, like a living thing. An unknown malady is attacking the stained-glass panes of cathedral windows in Europe. The sickness makes the colors deepen, and the glass flakes off in small pieces until the panes are as thin as tissue-paper and will crumble at a touch.

The effect of rapid vibrations from the music of the organ is suggested as a cause, but it seems equally probable that the disease is a little-understood effect of the actinic rays of sunlight—comparable, perhaps, to the radium and X-ray emanations that turn clear glass a deep purple.

Folding Top Adds to Buss Riders' Comfort



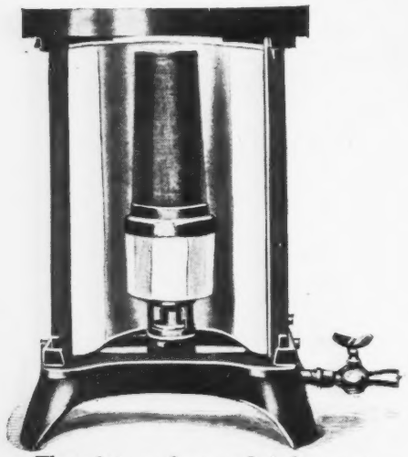
How the hood unfolds as its uprights slide along rods on each side of the bus is shown in the upper photograph. Below is the folded hood in its receptacle

FOLDING down in front of the driver when not in use, a hood now carried by London buses can be raised instantly to protect the passengers against a sudden shower. The arrangement is extremely simple. The hood is supported upon wooden uprights, which slide along a brass rod attached to the rail of the bus, while the cover itself folds up like a concertina. At the forward end of the coach, the supports fall forward on hinges and the hood drops into a receptacle behind the glass wind-shield.

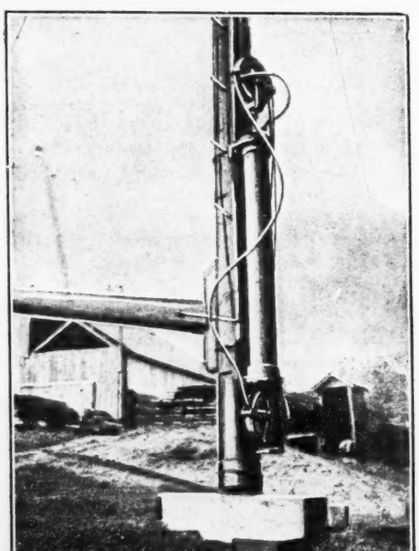
Novel "Safety" Gas-Heater Both Warms and Lights Room

THE fact that highly poisonous carbon monoxide gas is given off to some degree by almost all forms of gas-heaters is responsible for the general feeling that it is dangerous to burn gas-heaters in confined spaces. This new heater of French invention is said to produce no carbon monoxide whatever.

The gas is thoroughly mixed with air in its passage through a series of cone-shaped openings, and is burned as it passes through the fine meshes in a wire screen. This makes the burner consist of nearly 20,000 tiny Bunsen burners and results in complete combustion. A core of refractory earth is heated by the flame so that the gas from an ordinary incandescent mantle will give a temperature of over 1000° F., making this device a heating unit of the first order. The incandescent mantle and core also give as much light as a Welsbach mantle.



The mixture of gas and air burns as it passes through a wire screen



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Lumber-Yard Uses Air Engine for Hoisting

BOLTED directly to the mast of a boom derrick, and hence occupying no ground space, a novel compressed-air hoisting engine installed in a Western lumber-yard attains unusual hoisting speed for an engine of such simple design.

It consists simply of an air cylinder six feet long. On the bottom head of the air cylinder are mounted two sheaves and bearings. A third sheave is placed on the top of the piston-rod, bolted to the cross-head that works in a pair of guides attached to the derrick mast above the cylinder.

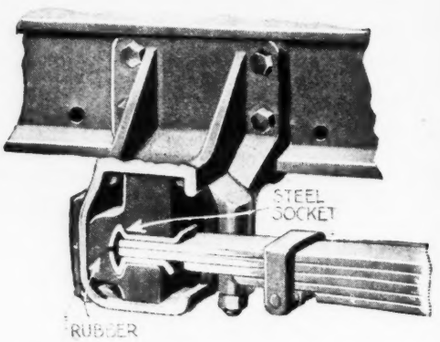
When air is turned on, the piston rises for a total stroke of six feet. The arrangement of the sheaves converts this into a cable lift of 24 feet. The cylinder is about ten inches in diameter.

Rubber Spring Blocks Absorb Motor-Bus Jolts

RUBBER spring blocks replace the usual spring shackles in an auto-bus model now being manufactured. Buses so equipped ride as easily as the best of touring-cars, it is claimed. The end of the spring is inserted in a large block of very resilient rubber, which is held fast in a housing riveted to the chassis frame.

In order that the springs may also carry their proper share of the load, lipped plates are bolted to the ends of the two-top spring leaves. These plates fit into the spring block, which encloses the lips. Stretching the block in this manner puts the upper and lower members of the block under a compression of about 100 pounds to the square inch when bolted up.

The rubber block acts very much like a shock absorber of the cushion type,



although in this case the spring pad is always in compression. The designers claim that the rubber blocks are easier to replace than the bushings and pins of the ordinary form of spring suspension, and that the life of the block in service is over 30,000 miles.

Detachable Blade Converts Hammer into Hatchet

A COMBINATION hammer and hatchet has been invented by Stuart Moseworthy, of Cambridge, Massachusetts, for the use of carpenters working in inconvenient and high

places where it is desirable to carry as few tools as possible. The hatchet blade is recessed to fit the hammer face, and a clamping-bolt is inserted through holes drilled in the jaws of the blade and the hammer head.

Side clips are also provided that further secure the hatchet blade to the rest of the tool when it is being used as a hatchet. A guard for the cutting edge protects the blade when the tool is placed in the pocket or when the hatchet part is removed to use the tool as a hammer.

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Twenty-Mile Voyage in Motor-Cycle Side-Car

PHILIP JOHNSON and John E. Hogg, of Los Angeles, paddled twenty miles in the side-cars of their motorcycles. For hours they were out of sight of land.

They came to the Salton Sea to photograph wild birds on the island in its center. Finding themselves unable to hire a motorboat, they caulked up the side-cars and set out. The voyage took all day, and

Two photographers seeking bird views paddled twenty miles in motorcycle side cars

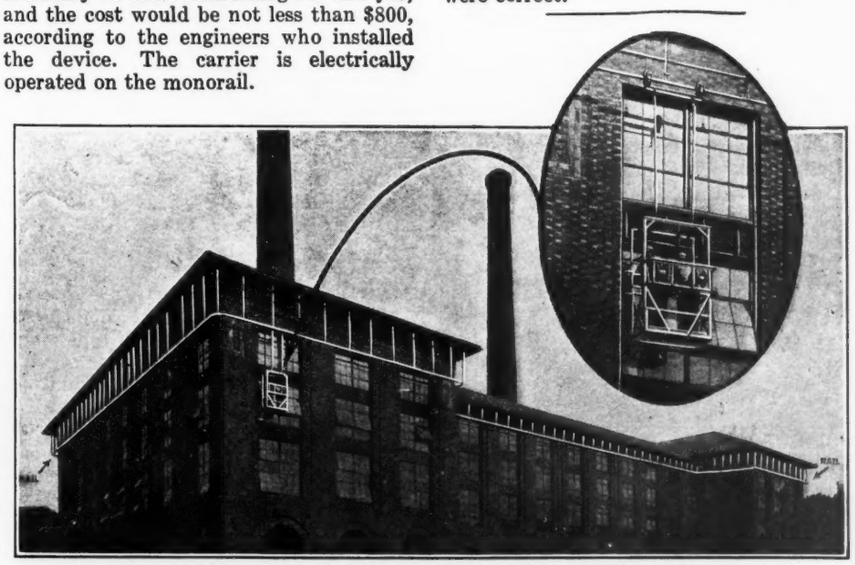
as the temperature was 125 degrees in the shade, their sufferings from heat and thirst were intense. There would have been no possibility of rescue if their improvised boats had capsized, but they got their pictures and paddled back without any accident whatever.

NEW French coinage to replace the paper money now in circulation will be made from an alloy of bronze and aluminum.

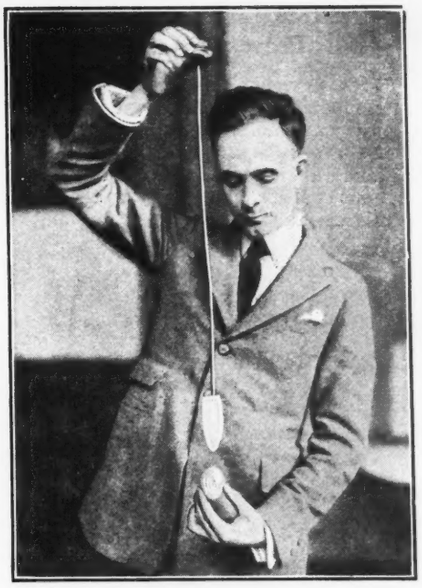
Windows Are Washed from Suspended Tram-Car

NO chance for a washer to fall from the windows of a factory recently erected in Cleveland, Ohio. A light carrier-car is swung on two wire ropes from a rail running entirely around the building, under the eaves. Two small winches enable the platform to be raised or lowered to any desired height, and two trolley rollers supported by the rail permit the cage to be moved from window to window.

There are 4600 windows in the building illustrated, and they may be cleaned by three men in twelve days with the assistance of this equipment, at a cost of $172.80. Without the use of the car, it would be necessary to erect scaffolding for this job, and the cost would be not less than $800, according to the engineers who installed the device. The carrier is electrically operated on the monorail.



A permanent window washing trolley saves thousands of dollars annually in keeping the 4600 windows of this factory clean. The monorail does not detract from the building's appearance



Will the Egg Grow Up to Be a Hen or a Rooster?

WHETHER an egg is a potential rooster or an embryonic hen can be determined, it is claimed, by a "sexometer" which may prove to be of value in the poultry industry, for when the sex of eggs can be told, it will be possible to send most of the rooster eggs to market and retain the hen eggs for the upbuilding of the home flock.

The "sexometer" consists of a piece of cork wound with copper wire from which is suspended a pendulum of wire ending in a flat piece of aluminum-plated substance. In examining the egg, the cork is held in one hand and the egg in the other. If the egg is male, the pendulum, it is claimed, will swing in a circle. If it is female, the pendulum is said to swing back and forth.

It has been demonstrated that the device, when held over one egg, will swing in a circle; yet when it is held over another, it will swing back and forth. Whether these varying motions are due to the sex of the egg, or to such incidental qualities as shape and size, is a puzzle that no one has been able to answer. The inventor claims that in experiments covering a period of six months, the instrument forecasts on 85 per cent of the eggs tested were correct.

Bicycle and Wheel Chair Become Jaunting-Car

A BICYCLE with a motor attachment, and a wheel chair for a trailer is the combination that makes up the latest jaunting-car. The trailer is attached to the bicycle by means of a curved piece of iron pipe leading to a universal joint under the saddle.

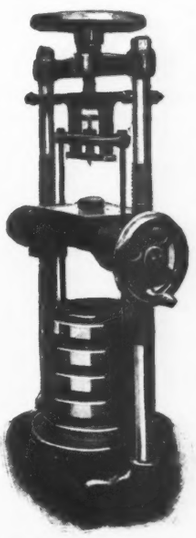
The feature of the motor is the vertical drive, attached to the front wheel of the

A small motor on the front wheel post supplies enough power for bicycle and trailer

bicycle. No change has been made in the rear wheel. The rider must be careful not to turn corners too sharply, or the trailer will overrun the bicycle.

Machine Tests Hardness of the Thinnest Metals

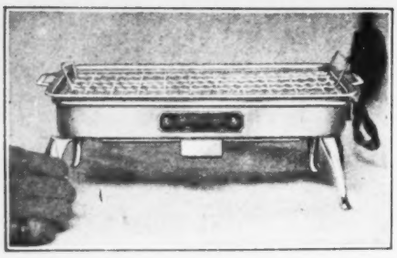
DEVELOPED for use with material too thin to withstand testing by the standard ten-millimeter ball of the Brinell method, comparative tests made in the Woolwich Arsenal, England, have shown a newly developed machine to be equally accurate. It was invented during the war to test the walls of small-arm cartridges after they had been loaded with powder.



Balls only two millimeters in diameter and loads up to fifty kilograms are used in this machine to test the hardness of very thin metals

The standard Brinell method is followed in principle in this machine, the difference lying in the use of small balls and small loads. The balls used are one and two millimeters in diameter, and the loads range up to fifty kilograms. The object to be tested is placed on the table, and raised or lowered by the hand wheel until it bears against the ball-holder on the crosshead. Finer adjustments are effected by leveling screws on the base plate and a fine-pitch non-rotating screw on the ball-holder, operated by the upper hand wheel. The proper weights are then placed in the lower part of the suspension stirrup to which the ball holder is attached. The maker claims this instrument will determine the hardness of material, a hundredth of an inch thick.

THE demand for turpentine requires 800,000 acres of virgin forest annually.



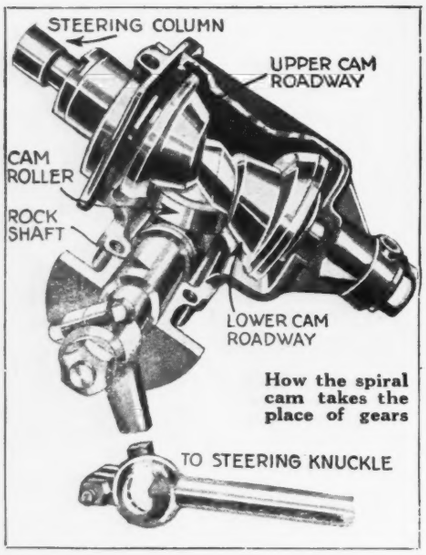
Knock-Down Toaster Fits Traveler's Grip

TAKING up a space only ten by six by two inches in the traveler's grip, a novel folding toaster can be quickly transformed into a standard size utensil. The legs fold out of the way against the frame, which is recessed so that the legs will not project and tear articles near them.

The base of the body is grooved, and into this fits a removable shelf for catching crumbs and grease. The toaster tray can be taken out for broiling or light cooking.

New Gearless Steering-Gear Is Always Tight

A GEARLESS, irreversible steering-gear in which the shaft is directly connected with a spiral cam acting on a roller that operates the "linkage," has recently been perfected in England. The new design is said to be easier to operate than the usual steering-gear, and to eliminate back-



How the spiral cam takes the place of gears

lash altogether. Due to the fact that large surfaces in rolling contact are substituted for small surfaces in sliding contact, wear is imperceptible and the steering-gear is always tight.

The roller is pivoted at right angles to the shaft that moves the drop-arm. The drop-arm, found on all steering-gears, is the short lever attached to the shaft that moves the linkage running to the front wheels. In this model a dual cam, or a double roadway in which the roller can travel, is necessary to hold it solidly.

This double spiral roadway forms an arc, and is so designed that when the wheel is cramped to the right, the roller is at the extreme top of the pathway, and when cramped to the left, the roller moves to the very bottom. These inclined pathways act like a screw-jack, and make additional gearing in the steering-wheel unnecessary. Ball bearings are used throughout, even in the cam-roller.

Telltale Light on Lamp-Post Prevents Accidents

TO prevent collisions between fast-moving automobiles and dark lamp-posts on winding roads, C. G. Beckwith, of Cleveland, has invented a boulevard standard with bull's-eyes of colored glass about one third of the way up the post.

When the main light is burning, the

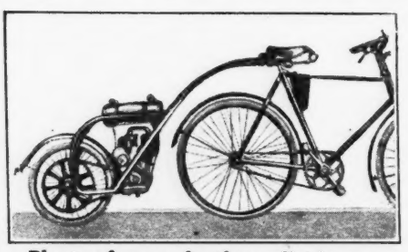
Bull's-eye lights flash a warning

telltale lamp behind the bull's-eye gives only a faint glow, but if the main lamp fails, the telltale lamp is automatically subjected to greater voltage and shines brightly.

Motor Pusher Saves Legwork

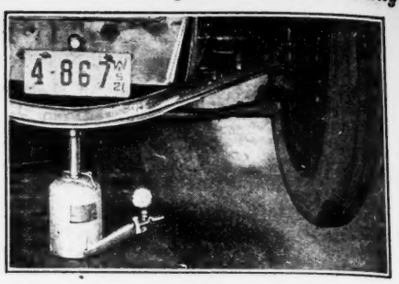
A FULL-SIZE one-cylinder motorcycle engine makes this bicycle attachment unusually powerful. A very low gear is used to keep the speed moderate.

A hinged and pivoted joint behind the saddle enables the power unit to rise and



Plenty of power for the cyclist is supplied by this one "cylinder pusher"

fall in conforming to irregularities in the road. Flexible wires are led from the engine up the connecting piece and along the frame of the bicycle to the handle-bars, so that the engine is controlled in much the same manner as a motorcycle.

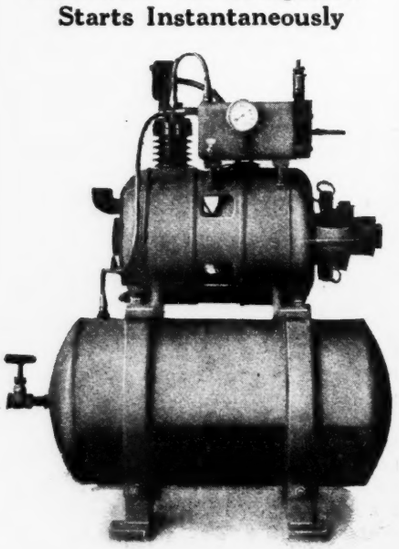


Air Pressure Runs Jack for Motor-Car

A PNEUMATIC jack, operated by compressed air from an ordinary free air hose or the engine tire pump, will lift a car without any manual labor whatever. The mechanism consists simply of a heavy cast-steel piston and a large piston-head attached to a rod that extends upward through a hole in the cover. Air is admitted to the under side of the piston.

After the car has been lifted the required amount, a turncock on the air line is closed, and the car held in place by slipping a steel pin through one of the numerous holes bored in the piston-rod. The device is made in three sizes to lift 2200, 4200, and 8000 pounds, but all models operate on the same air pressure. If necessary, the power can be supplied with a hand pump, but the device is designed especially for cars equipped with some mechanical means for compressing air.

Automatic Air Compressor Starts Instantaneously



BETTER tank mounting and a magnetic air-pressure release are the improvements in an automatic air compressor for garages and service stations requiring constant pressure in air lines.

The magnetic pressure release enables the motor to start without a load. This assures instantaneous starting and a small initial consumption of current. The air pump is of the rotary type, and is driven directly from a low-speed, ball-bearing compressor-type motor built directly into the pump. No gears are employed. It is possible to mount the compressor unit on the top of the air-storage tank, reducing the floor space occupied by the machine.

A COLD method of making porcelain in which the material is not fired in the kiln, is reported from Germany. The hardening process is a secret.

Compact Threading Machine Weighs Only Ninety Pounds

A BENCH threading machine that weighs only 90 pounds and takes up but 9½ by 29 inches of space on a bench, consists of a single casting, carrying a spindle mounted on bronze bearings.

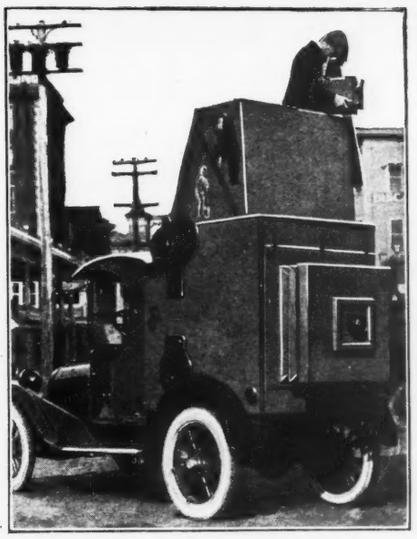
The spindle is driven by a three-step cone pulley and carries a self-opening rotary die-head operated by a yoke lever and trip-rod. Adjustable stops arranged on the trip-rod govern the point of opening and closing of the die-head. A forward motion

The threading machine is less than ten inches wide

of the carriage opens the die-head and a backward motion closes it.

The carriage is equipped with a two-jawed chuck operated by a hand wheel, and an adjustable swinging stop on the side of the chuck provides for an accurate setting of the work for a predetermined length of thread.

FEEDING yeast to laying hens is not beneficial, and ultimately decreases their egg yield, reports the Department of Agriculture.



News Photographers' Auto Is an Oversized Camera

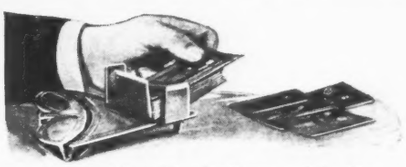
PROGRESSIVE newspaper photographers of Atlantic City, New Jersey, have installed an auto body modeled after a camera, from which they take pictures of the news events in that vicinity. In addition to its advertising value, the odd body provides space for a darkroom in which plates may be developed on the way back to the office.

A ladder in the interior leads to a platform at the top of the huge "camera" 10 feet above the ground. This elevation enables the camera men to get unusually effective pictures of crowds and sporting events.

Machine Aids One-Armed Man to Shuffle and Deal Cards

GROOVES and the folding card-rack on this machine take the place of one of the player's hands. By its use a one-armed man can enjoy a game of cards without being embarrassed by any awkwardness or slowness in dealing. After dealing, cards are held with their lower edges placed in a semicircular groove just back of the dealing device.

In shuffling the cards, they are placed between the side flaps and riffled by taking a number from the bottom of the pack and throwing them upon the top with a jerking motion of the fingers—exactly as it would be done with two hands. To deal, the pack is pressed against one of the side pieces by

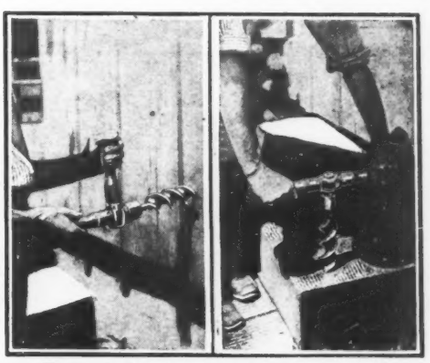


Just back of the dealing-rack is the circular groove that holds the cards

the fourth and fifth fingers, and the cards dealt out with the thumb and forefinger. The device has been tested by disabled veterans and found highly satisfactory.

Adjustable Auger Handle Helps in Cramped Spaces

AN auger handle with the adaptability of a ratchet brace, which facilitates boring in cramped and restricted spaces, has been invented by Mr. W. H. Stiner, of Kennett Square, Pa. The handle can



Two of the four positions in which the new auger handle can be used

be used in four different positions. In the open, it is used as an ordinary auger handle with both arms horizontal, but if need arises, either arm can be mounted above the bit-clamp to serve as a pivot, and the bit turned with the other arm alone. This feature makes it possible to use the tool in half the usual space.

The ratchet feature can be applied on either side, or in either direction, and is useful where machinery or walls prevent the carpenter from turning the handle in a complete circle.

FARMERS have begun to compete with coal-miners, for corn at 20 cents a bushel is equivalent in heat value to coal at $10 a ton. Corn is excellent fuel. Pound for pound, it contains two thirds the heat value of coal. While our coal resources seem to be failing, science may find a way of growing vegetable fuel fast enough to meet all requirements. Last year's corn crop, it is claimed, would meet fuel requirements of all industrial plants in the United States for about six months.

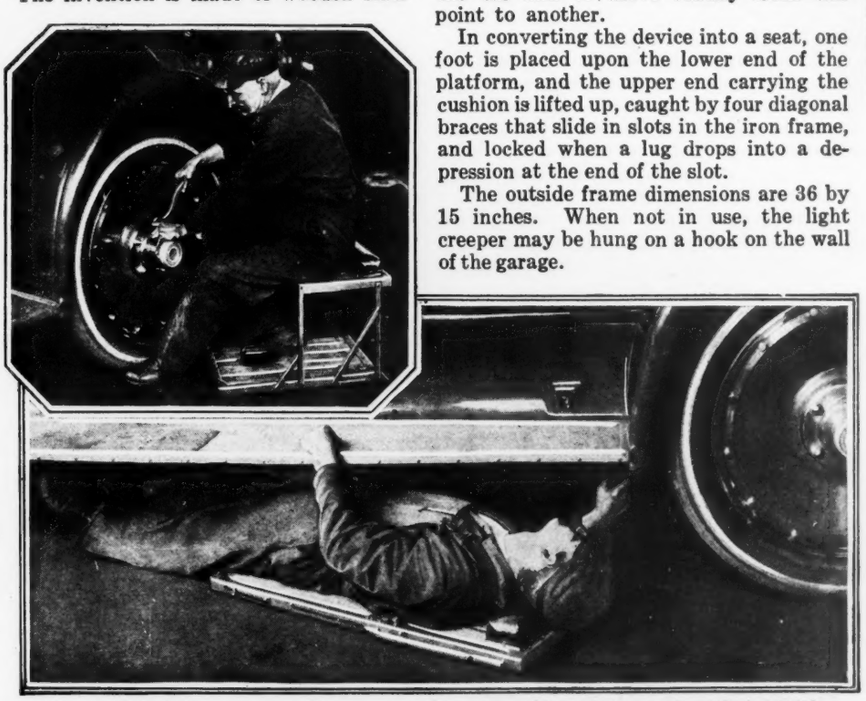
"Creeper" Adds Comfort to Work under the Car

CRAWLING under the car to make repairs is a pleasanter task when the mechanic can lie on a comfortable creeper. The newest improvement in this field is a folding creeper that can be converted into a seat to eliminate stooping and kneeling when repairs are made near the floor.

The invention is made of wooden slats mounted in a channel-iron frame, and is fitted with a leather-upholstered cushion head support. When used as a creeper, the seat lies flat, and the whole device is only one and one half inches high. Rollers on the bottom of the frame permit the mechanic to shift it to any position under the car and to move readily from one point to another.

In converting the device into a seat, one foot is placed upon the lower end of the platform, and the upper end carrying the cushion is lifted up, caught by four diagonal braces that slide in slots in the iron frame, and locked when a lug drops into a depression at the end of the slot.

The outside frame dimensions are 36 by 15 inches. When not in use, the light creeper may be hung on a hook on the wall of the garage.

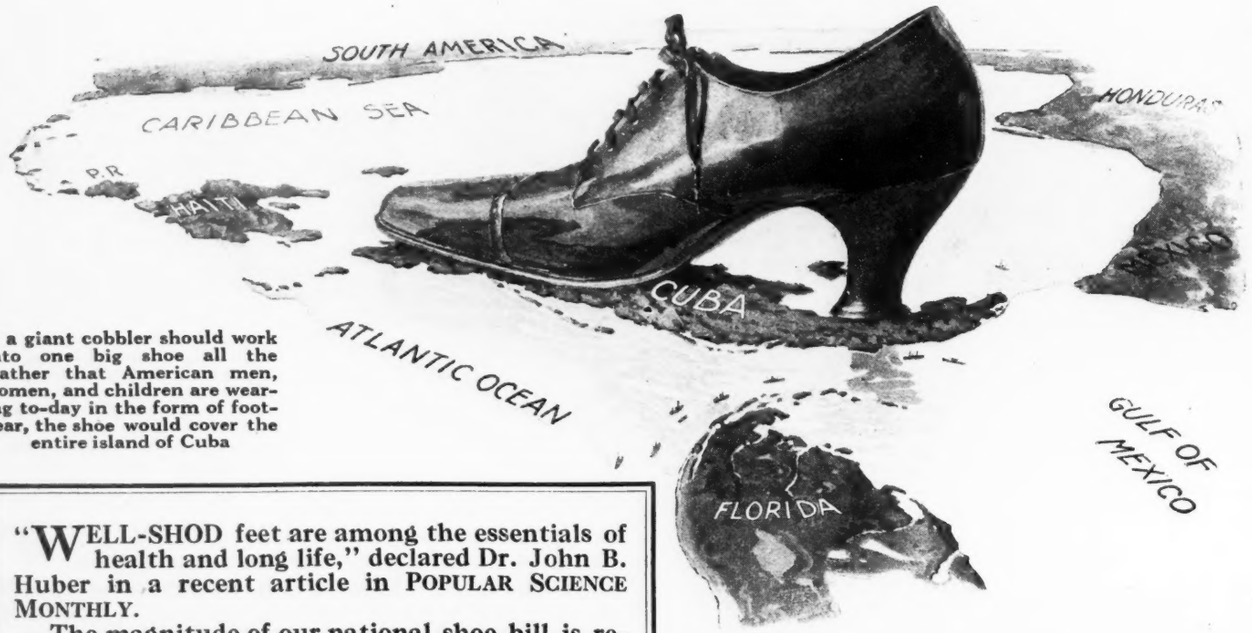


Above—Folded into a seat, the creeper does away with stooping or kneeling. Below—When you can rest your head on an upholstered support, work under the car is easier

How Scientists Are Taking the Pinch Out of America's Billion-Dollar Shoe Bill

New Tanning Discoveries Will Bring You Cheaper Footwear

By John Walker Harrington



If a giant cobbler should work into one big shoe all the leather that American men, women, and children are wearing to-day in the form of footgear, the shoe would cover the entire island of Cuba

"WELL-SHOD feet are among the essentials of health and long life," declared Dr. John B. Huber in a recent article in POPULAR SCIENCE MONTHLY.

The magnitude of our national shoe bill is revealed in this story of new discoveries in tanning, which hold forth hope of a coming fall in every family's expenses for footwear.

THE expense of keeping the feet of the American people off the ground has been so high since leather went to war that every shoe pinches a pocket-book. The enormous cost of keeping us shod may be comprehended when we consider that according to the last available census of manufactures, $1,149,560,000 worth of boots and shoes are produced annually in the United States.

In fact, this sum nearly equals the cost of providing our daily bread; for the value of wheat flour made annually in the United States, according to the same census, was $1,436,388,000, or only about $300,000 more than the sum at which the boots and shoes were appraised.

New Discoveries in Tanning

Science, however, is now at work to slice America's shoe bill. In the chemical laboratory and in the machine-shop speedy processes of tanning leather are being substituted for the slow and expensive methods handed down through generations. New materials that can be made available for footwear are being discovered and developed. As a result, there is substantial hope that new, improved processes will help to cut at least 25 per cent from the cost of shoes, saving $287,390,000 annually.

If all the boots and shoes worn by the men were placed end to end, allowing 12 inches as the length of each, they would reach four times around the earth and still there would be enough left to keep a few regiments on a war footing.

Suppose that some giant cobbler should work all the leather used in all the footgear of the men, women, and children of this country into one big shoe! He would need the entire 800 square miles of the island of Cuba on which to put it. This would not, of course, include the slippers and the babies' shoes, so he would have to save the island of Manhattan in the center of New York for the infant size.

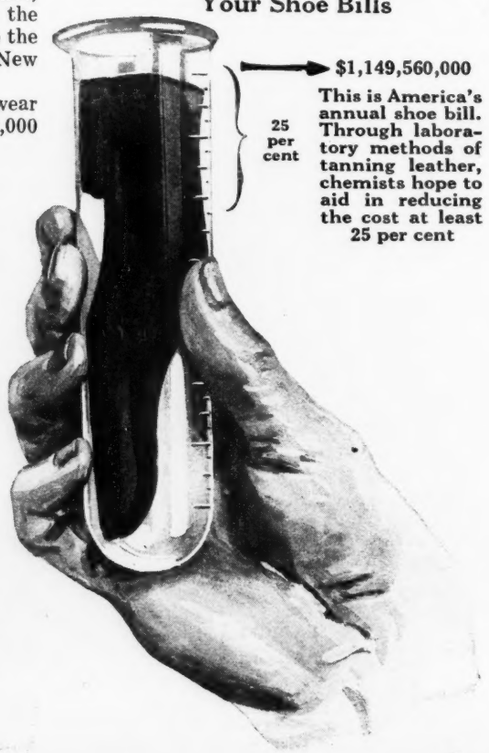
Some of the younger generation wear cloth and fiber shoes, of which 8,000,000 pairs are made a year, but in the main the hides of the ox and the bull, the skin of calves and of kids is used in the manufacture of footgear. The day is not far distant when the shark and the porpoise, or the white whale, will yield a far larger percentage of their hides to the tannery than they do at present.

As science takes a still deeper interest in our shoes, many more kinds of skins and hides will be made available for our wear. Indeed, the time may come when we shall be satisfied with mashed paper heels and when rubber will be adapted to all kinds of weather.

Looking into the future, there is much hope for less costly footgear in the many new processes for tanning leather quickly that are now being perfected by up-to-date chemistry. Of all the trades, that of tanning leather seems to have been about the last to come under the control of science.

Every commercial variety of skin or hide has to be prepared in some way before it can be used for human wear. The pelts of animals, when removed, will dry up or become hard, or even rot, unless they are prepared to withstand decay. Tanning is the chemical process that preserves them, makes them comfortable to the human foot, and keeps out moisture. When a hide has been tanned, it has under-

How the Laboratory Is Cutting Your Shoe Bills



This is America's annual shoe bill. Through laboratory methods of tanning leather, chemists hope to aid in reducing the cost at least 25 per cent

gone certain changes in its fibers that make it a new product. Chemistry has waved its magic wand over it, and has made it new.

Despite this fact, however, chemistry has had little to say about tanning until the past few years. In the past, the formulae for making the tanning liquors have been handed down from father to son. If hides have been spoiled, the moon has been to blame and the public has paid for the damage.

Old Methods Are Costly

What a hard working citizen is the old time tanner, in his rubber boots and his stained apron! As stubborn as the blind mule that grinds the bark for the vats, he wades around in tons of wet bark and hauls away at the dripping hides for months before he is ready to say that he has made leather. Even in some of the most up to date tanneries, from three to six months is required to prepare a hide for the shoemaker. All this is tremendously expensive.

With the new methods, it is possible to tan some hides in 24 hours, and the quality of the goods is as high, and even higher, than it was before science lent a hand in leather manufacture. The college professor has been leading the leather industry into ways of economy by employing substances that will work the chemical changes of tanning quickly.

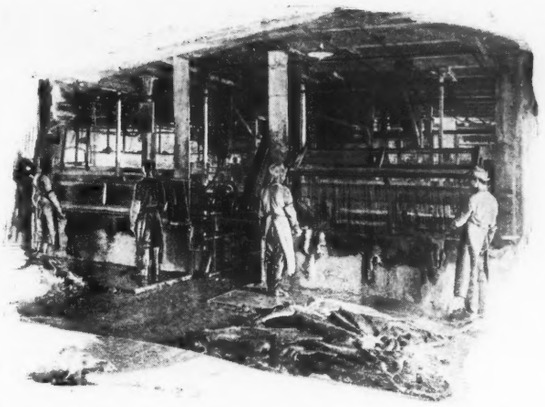
It took the college professors in the great leather school at the University of Leeds, England, to show the tanner how he could save time and money. Within the past few years, the American scientists have been coming to the fore, as was shown by the arrival of many delegates from England to attend recent meetings of the Section of Leather Chemistry of the American Chemical Society held at Columbia University, New York City.

Certain manufacturers have created a substantial fund for the investigation of the facts of chemistry that apply to tanning, and have placed the reports of those researches at the disposal of their competitors. Part of the fund is used at Columbia by Professor Arthur W. Thomas in running the smallest tannery on earth, which occupies only a square yard. Small bits of hide are in this tiny plant put through all the processes of the big establishment, and their structure is studied under the microscope. At Pratt Institute, in Brooklyn, is another center of the new tanning art, where up-to-the-minute tanners are pupils.

Exact Knowledge for the Tanner

One of the new wrinkles in the tanning of skins is the gaging of tanning materials by the electrical discharges that come from them. This process gives to the tanner an exact knowledge of the work that his materials will accomplish. By studying the nature of the structure of the hides more closely in the light of the new knowledge of the colloids, that is of substances similar to gelatine, the tanner of the new school has his material tested in advance, so that he can tell just how it will act, instead of depending upon mere luck.

The modern tanner obtains extracts of his vegetable tanning ingredients, instead of making use of the substances themselves. He has learned, too, that the astringent action is due to tannin, its active principle, and that the making of the astringency is connected with the electrical charge of those tannin particles. The higher the charge, the greater the astringency. As a result of such discoveries, blind use of certain vegetable extracts is no longer necessary, since the properties peculiar to one kind can be obtained from an entirely different extract by simple treatment, according to the principles of colloid chemistry."



Fleshing and glazing machines in modern American tanneries are replacing the old method of removing the flesh from hide and skins by hand

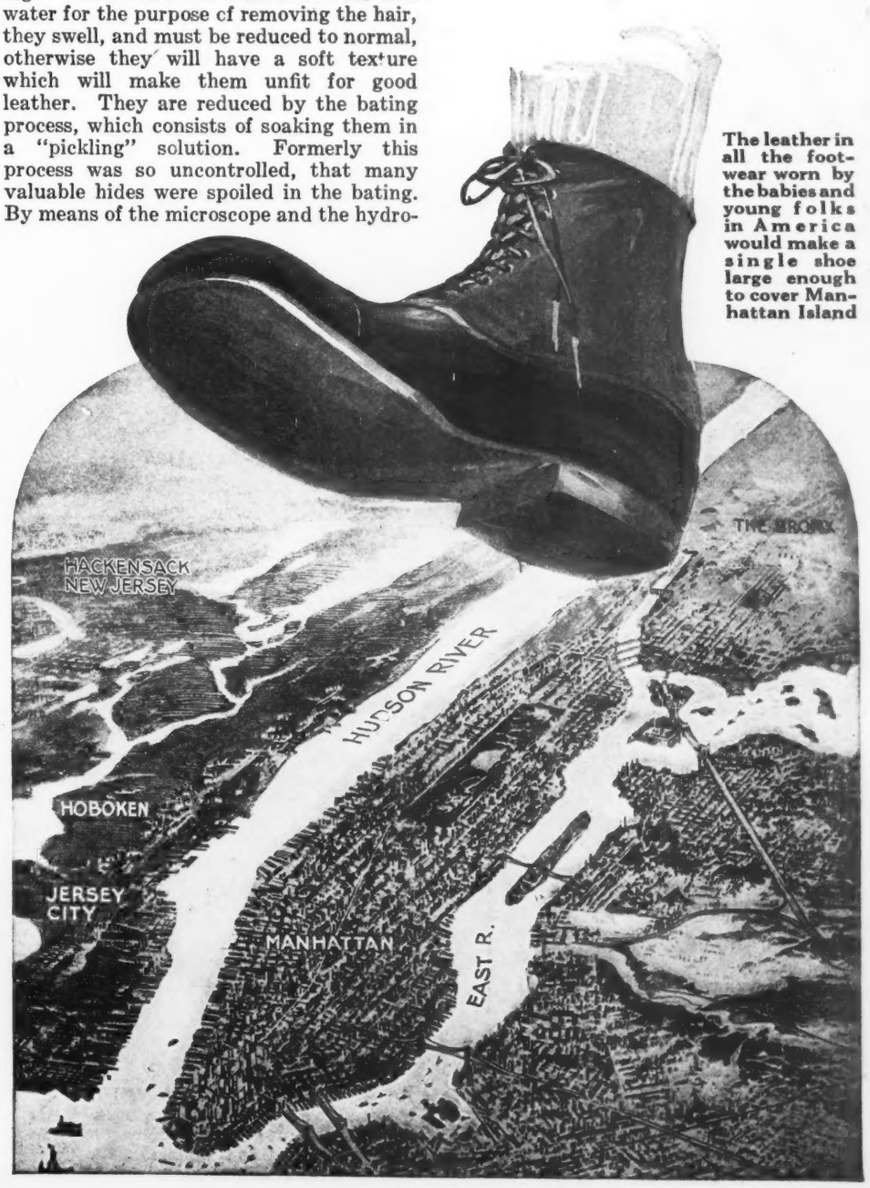
One of the most difficult problems in tanning is known as the regulation of bating. When hides are soaked in lime and water for the purpose of removing the hair, they swell, and must be reduced to normal, otherwise they will have a soft texture which will make them unfit for good leather. They are reduced by the bating process, which consists of soaking them in a "pickling" solution. Formerly this process was so uncontrolled, that many valuable hides were spoiled in the bating. By means of the microscope and the hydrogen electrode, the nature of the action of the bating liquors has been established and a method devised for managing and directing the process that has changed it from the most mysterious to the most scientific process in the tannery.

Hides Tanned in Eight Hours

The leather chemist of the present day advocates the chrome process of tanning, where speed is desired. This consists in submitting the structure of the hide to certain chemical changes, by adding bichromate or potash or such substances to the vat liquors. By this method, hides have tanned within eight hours. For many purposes, the chrome leathers are preferred. Certainly they are made in a manner that does not keep the money of the tanner tied up in his vats.

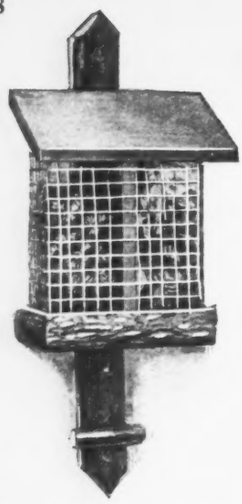
In the opinion of the leather chemists, the whole art of tanning is likely to undergo still more radical changes in the next few years.

Through such described shortening of schedules, this revolutionary move will make its influence felt at the cobbler's bench and in the retail store so that the American public may have better and at the same time cheaper shoes.



The leather in all the footwear worn by the babies and young folks in America would make a single shoe large enough to cover Manhattan Island

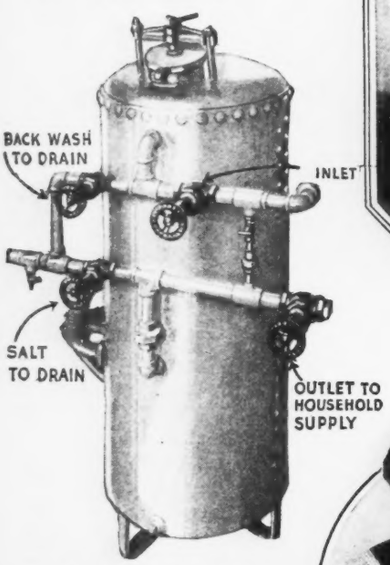
One of These Household Brighteners Is Just What Your Home Needs



Nest-building material, such as bits of wool, cotton yarn, and feathers, offered to the birds in a screened box, will induce them to nest near by

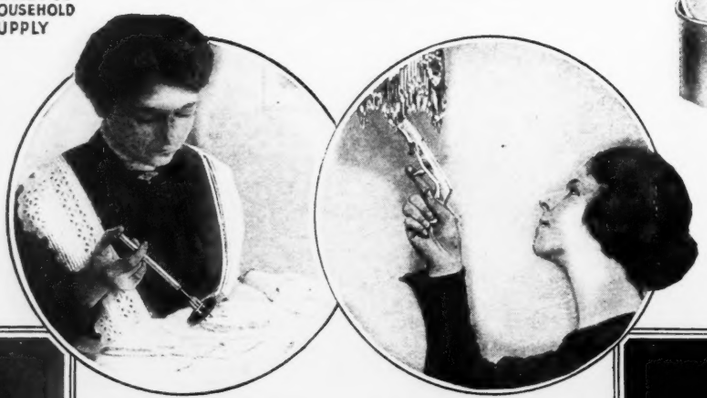
Here is a small electric range, supplied with current from an ordinary light socket. By careful management a full meal for five persons may be cooked on this range in a short time and economically

The new juice filter shown above stands solidly on its own legs and may be folded up when not in use



Hard water is unsuited for household purposes and must be softened before it can be used. The filter shown above is connected with the supply pipes

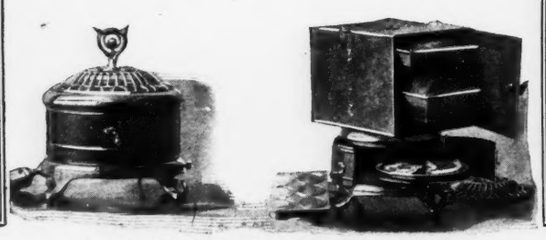
When the boiling point is reached in this combined electric stove and fireless cooker, the steam causes the thermostat to cut off the current



The handle of the serving fork illustrated above is equipped with a sliding pusher that discharges food from fork if the thumb is pressed against it

When you pull the trigger of this pistol gas lighter, a burred steel wheel at the muzzle rotates against a small flint, and the sparks light the gas

Fruits or vegetables placed in the conical colander are pressed to pulp by a wooden plunger and forced through the holes of the sieve



An electric heater (on the left) may be changed to a miniature baking oven by the use of a removable attachment (on the right), which takes the place of the ornamental top of the heater

A convenient attachment to the kitchen table is this sanitary catch-all, which may be lined with a double thickness of newspaper folded like a pocket

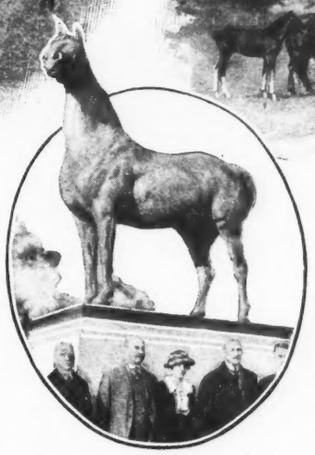
New Birdlike Wings for Airplane Save Power

SUCCESSFUL tests of a new form of airplane wing modeled after the wings of soaring birds may result in radical changes in airplane design in the future. This prediction is generally made following a recent demonstration of the "Alula" wing, illustrated and described in POPULAR SCIENCE MONTHLY for February, 1921.

In the test flight the trial airplane reached a height of 3000 feet in 72 seconds—demonstrating the excellent lift of the wings. These resemble those of a bird both in outline and cross-section, as each is arched at the center and tapers away to a point at the tips.

In the ordinary airplane wing there is considerable loss of power and lift due to inefficiency at the tips, but the new model is said to utilize the entire lifting surface efficiently.

The wing has a surface of single-ply mahogany built on ribs, with stretcher pieces lying between the ribs. Because of the varying curvature of the wing, spars of the usual type are impossible.



Compare this statue of the famous sire of the Morgan breed with his descendants in the upper illustration

Statue Built in Memory of Famous Horse

A STATUE in memory of Justin Morgan, the famous horse that founded the breed bearing his name, was erected recently at the government's Morgan Horse Farm, at Middlebury, Vermont, where Justin's descendants are still preserving his noteworthy traits after 20 generations.

Justin Morgan was foaled in 1789. In endurance and general utility he was one of the world's great horses, and his descendants were in universal demand when endurance was more to be desired than speed. The characteristics of the breed have been maintained for over 200 years. The short back, long, oblique hip and shoulder blades, and the exceedingly broad and muscular loins, which were the outstanding points of Justin Morgan, have been conserved in his descendants.

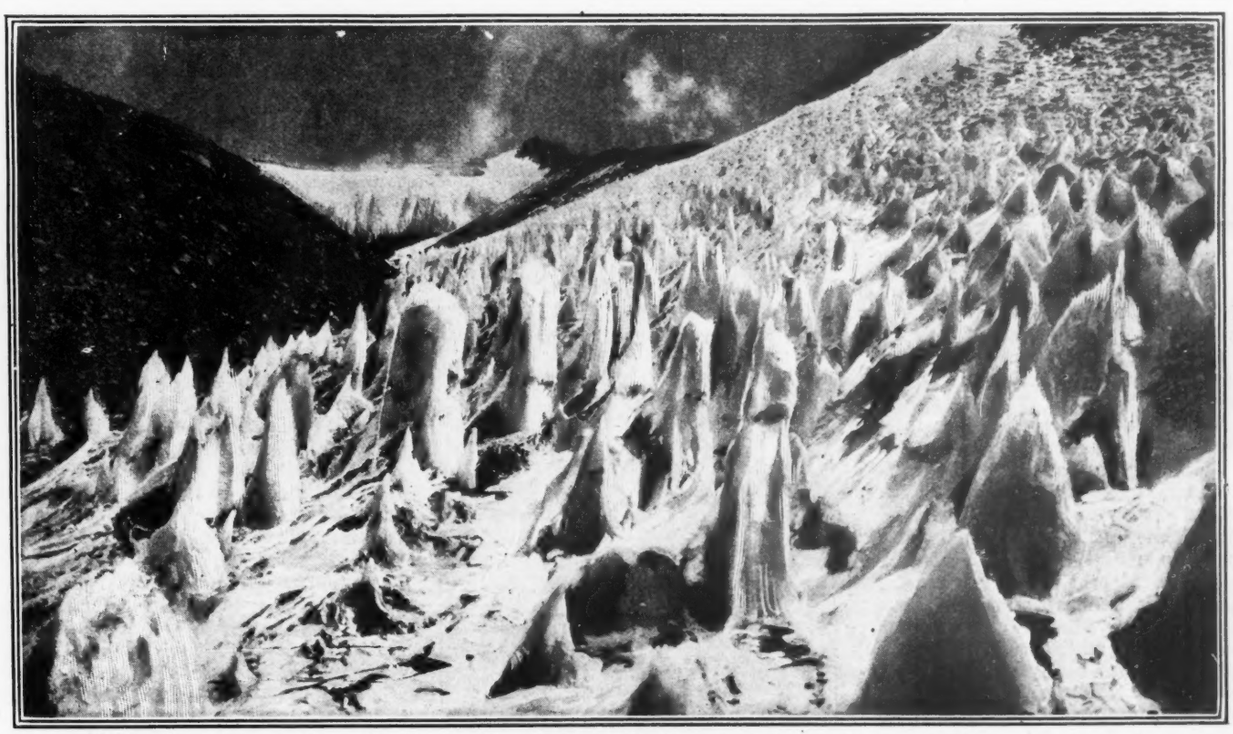
Castor the sturdiest descendant, in a recent United States mounted service endurance test of 300 miles in five days, placed fourth among 17 entries.

Melting Snow Forms Congregation of "Kneeling Penitents"

WHEN warm sunshine and spring rains begin to melt the snow covering certain slopes of the South American Andes, a mysterious congregation of white-robed kneeling penitents assembles. For some inexplicable reason, the snow in this locality melts in pointed, triangular shapes that from afar closely resemble women with white shawls over their heads, kneeling in prayer.

This formation may possibly be due to the nature of the ground, which is a mixture of rocks and earth. If the snow over the stones melted faster during the winter, so that the alternate freezing and thawing gradually changed it to a pillar of ice, the heat and rains of spring would wash away the softer snow from around these columns and so carve the "kneeling penitents," or *"nieve penitente."*

Or, the mystery may be explained by the fact that snow, falling on rocks covered with an insulating layer of lichen, will remain unmelted a long time.



Melting into strange, triangular shapes, the snow in the Andes appears from a distance to be a host of mysterious, white robed beings kneeling in prayer on the mountain slope. The exact manner in which these figures are carved by nature remains unexplained

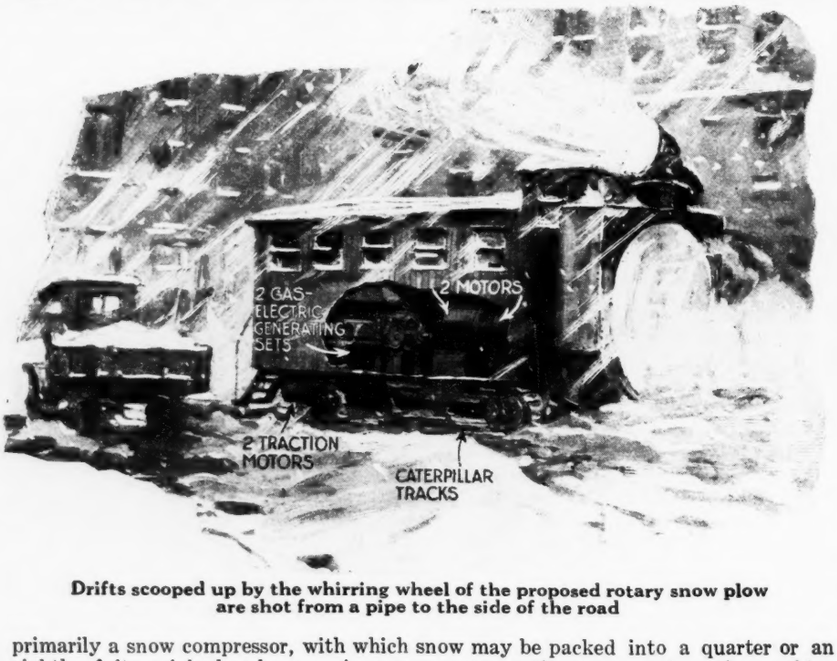
Noted Engineers Design Powerful New Snowfighting Machines

SOME blizzardy morning, if you live in a big city, you may look out of your window to see a monster motor-driven snow shovel creeping down the street, pushing its nose into high drifts, shoveling up snow at one end, and turning it out in the form of tightly packed snowballs at the other!

Or perhaps you may see a great whirring rotary plow, scooping up deep drifts and shooting out the loose snow through a funnel to the side of the street.

Machines such as these, proposed at a recent meeting of the country's foremost mechanical engineers, are designed to meet the problem of snow removal in large cities—now an out-and-out engineering problem. In particular, the experience of New York City with several heavy snowfalls has proved that it is better to depend upon mechanical equipment than upon a hastily recruited force of ill-clad and inefficient men.

The aim of the snow-removal engineer is to sweep the streets clean before the snow can freeze into ice, and to pack it densely so that the trucks may carry full weight as well as capacity volume. The machine proposed by Mark A. Guigou, of New York City, is primarily a snow compressor, with which snow may be packed into a quarter or an eighth of its original volume. A scraper rests on the street, and as the machine plunges into the drifts the snow is forced onto a conveyor belt that carries it up an incline and drops it into a packer. Here the snow is compressed between broad paddles, placed at right angles on two parallel axles. These turn in opposite directions. The compressed snow drops onto a screw conveyor that discharges it in solid cakes which can be quickly handled and loaded into trucks.



Drifts scooped up by the whirring wheel of the proposed rotary snow plow are shot from a pipe to the side of the road

Revolving paddle compressors in this shoveling machine pack the snow into solid cakes after it is forced up an incline conveyor

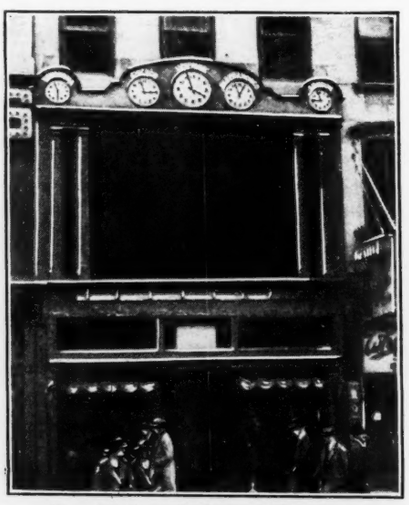
For deeper snow, D. L. Ellis, of Seattle, Wash., favored a gas electric rotary snow plow that will pick up the snow and shoot it either in a long pile at the side of the street or drop it directly into a truck. The rotor of this machine is a large wheel with cutting teeth and scoop edges. The loose snow is thrown off through a pipe which can be aimed to the side or downward. The machine runs on an endless tread, and derives its power from two 142-horsepower gasoline motors direct coupled to a 70-kilowatt generating set.

What Time Is It Now in the World's Big Cities?

A SET of clocks that tells at a glance what time it is in London, Chicago, San Francisco, and Yokohama is the latest device of a New York merchant to attract shop-window attention.

Looking at the clocks when it is three minutes before four in the afternoon in New York, one sees that it is three minutes of three o'clock in Chicago, three minutes of one in San Francisco, and three minutes of nine in the evening in London.

Far away in Japan the fishermen are looking through early morning mists, for it is six A.M. of tomorrow in Yokohama. Somewhere in the Atlantic ocean east of New York is the twilight of sunset, and west of Japan is the twilight of dawn.



Five clocks tell the world's time

THE efficiency of energy transmission by radio is virtually nil. The approximate ratio of radiated power to received power in transoceanic communication is one hundred trillions to one.

"Ultra-Microbes" Attack and Eat Disease Germs

ULTRA-MICROBES which prey on the germs of typhoid fever, dysentery, and bubonic plague are said to have been discovered by Dr. F. d'Herelle of the Pasteur Institute, Paris, who believes this new organism will help to check future epidemics. He claims to have made men, animals, and birds resistant to disease by introducing into their veins microbes that feed upon the disease germs.

All that would be necessary to check an epidemic like typhoid, Dr. d'Herelle is reported to have declared, would be to pour a small number of the ultra-microbes into the water reservoirs of a city. The ultra-microbe is tasteless and absolutely harmless to mankind and to all domesticated animals, as it will not injure the white corpuscles of the blood, he says.

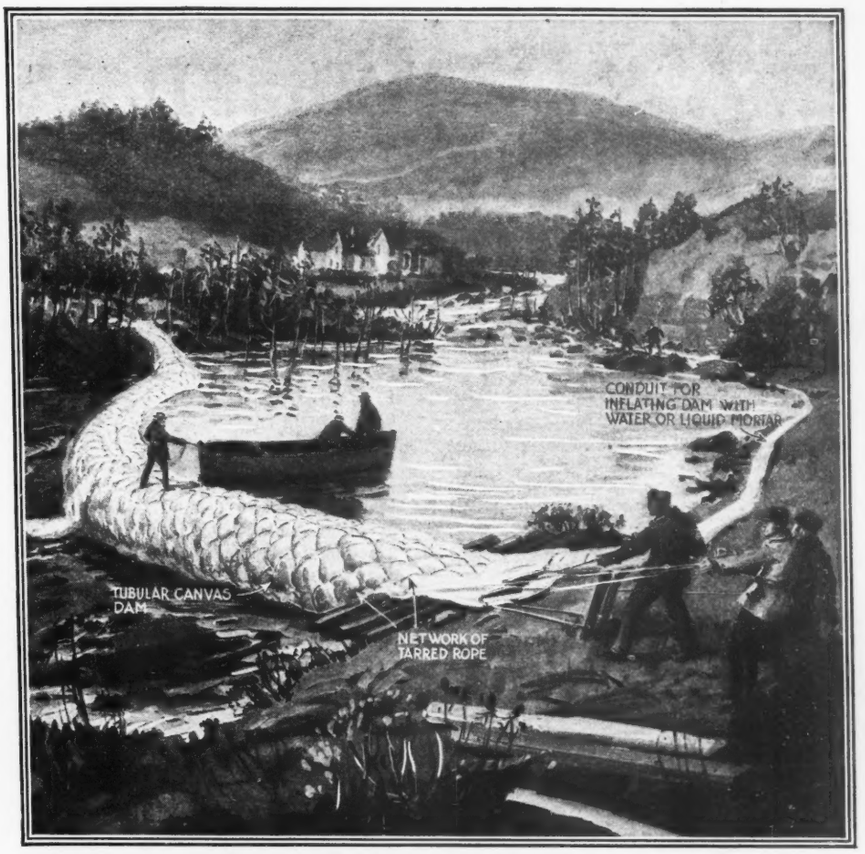
The Paris doctor has named his parasitic ultra-microbe the "bacteriophage."

Survey of Snow Forecasts Next Season's Fruit Crop

SNOWFALL this winter on the Rocky Mountains has a direct influence on the price of cantaloups in New York City next summer. For on the snowfall depends the amount of water that will be available for irrigating Western farms, and the produce sent to market will vary almost directly as the water supply. So, the more snow, the more fruit.

Snow survey is undertaken to learn as far as possible in advance how much water will be collected in the irrigation dams. Surveyors travel into the watersheds with indicating poles, which they thrust into the drifts. An aluminum spring balance with an adjustable index on the sampler gives the water content of the snow without computation, while Weather Bureau records indicate the depth of the fall. This is checked by measuring the depth of the drifts, and thus fairly accurate forecasts of the probable water supply for the coming season are obtained.

By thrusting a long indicating pole into snowdrifts at various points, the surveyor determines the depth of the fall and hence the water content of the snow



The huge canvas tube, filled with water, conforms to the river bed while the stream backs up behind it. At the right is the filler hose

Portable Canvas Tube Dams Shallow Stream

WHENEVER it is desirable to erect a temporary watertight structure quickly and cheaply, the portable canvas dam invented by Johan Störe, a Norwegian engineer, will meet the need.

The dam consists of a large canvas tube seven feet in diameter which is anchored in place across the bed of a stream and then pumped full of water. The weight of the gigantic hose makes it conform to irregularities of the bottom. The canvas is protected from the cutting action of sharp stones by an enclosing network of tarred rope.

During erection, one end of the tube is closed with a grip of beams with intermediate packing. The other end is placed on the river bank and the filling is accomplished in about 20 minutes through a small canvas hose led upstream.

The inventor spent seven years perfecting the dam, which is in use in many parts of the world. It may be used as a cheap permanent dam by pumping the canvas tube full of liquid concrete.

Motor Driven Grader Shaves Roads Quickly

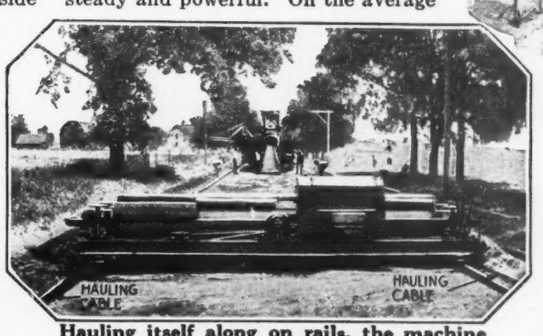
TRIMMING the subgrade of roads as smooth as a floor and true to grade, a new motor-operated grader that drags itself along the road by cables and works on the principle of the lathe milling cutter, promises economy and quick work in road-making operations. One man is in entire control of the machine.

The trimmer moves along the tops of rails built at the roadside, or upon the side forms placed to retain the concrete. It consists of a large roller carrying a series of four-foot digging buckets, equipped with removable steel plow lips, set to drive in five different places to depths varying from two to four inches. Two plows shave off the sides between the forms and the buckets, and the buckets trim the road.

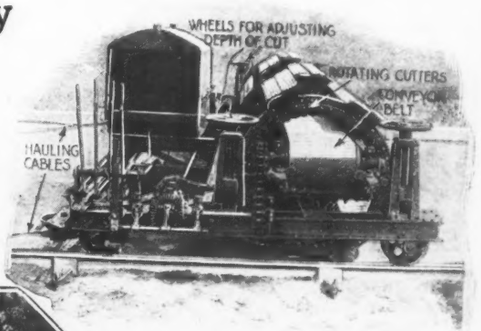
The excavated material is held inside the bucket lips until the buckets revolve to the top of the roller, when the earth, dropping out by gravity, falls on a conveyor belt running through the center of the roller and is carried to the ditch at the side of the road. The cutting depth is easily adjusted by means of hand-wheels on both sides of the machine.

The same gasoline motor that runs the cutting mechanism also turns two sheaves. These haul in two wire cables leading down the road, and so propel the cutters forward. The sheaves are operated by worm gears in order to make the movement of the machine steady and powerful. On the average road, the feed is three and one half feet a minute.

Contractors report that this machine has often dug up stones three and four inches in diameter, and that after one passage over the road the subgrade is ready for the application of concrete. As the cutting lips overlap, there are no ridges to be removed by hand.



Hauling itself along on rails, the machine trims the subgrade smoothly and discharges the excavated material at the roadsides. A concreting machine follows close behind



Rotating buckets with sharp lips dig into the road, then drop the earth onto a conveyor belt that dumps it at the side

What Do You Want to Know ?

Let Popular Science Monthly Answer Your Problems

Water Boils, then Freezes

Will water freeze in a vacuum?—J. C. T.

Yes, because as the pressure is diminished, the water will boil at lower and lower temperatures, and at the same time the temperature of the liquid will fall rapidly until finally, when the pressure approaches zero, the water will freeze.

How Copper Is Hardened

Is copper hardening considered one of the lost arts?—A. L. M.

No. There are several known methods of hardening copper, the most common being to combine with it a small quantity of cuprous oxide. The metal is also hardened by mechanical working.

Rifle Caliber Defined

What is meant by the phrase, "caliber of a rifle" ?—T. S.

The caliber of a rifle is defined as the exact measurement of the diameter of a cylinder which, bearing on the "lands," can be inserted in the bore of a gun. That is, a .22 caliber rifle has a bore which measures .22 inches in diameter from "land" to "land."

The Reason for Twilight

What causes twilight and what makes it disappear so suddenly?—E. B. L.

Twilight is made possible by the earth's atmosphere and its power to refract the sun's rays. For a certain time after the sun has disappeared below the horizon the sun's rays pass through the earth's atmosphere at such an angle that the particles in the air reflect and refract the light rays onto the earth. A few minutes later the sun will have sunk so low beyond the horizon that its rays pass out of the atmosphere and are not reflected.

Sun Appears Before It's Up

Is it possible to see the sun before it rises?—A. C. S.

Yes, due to the refraction of the sun's rays by the earth's atmosphere.

How to Resilver Mirror

Please tell me how to resilver a mirror?—D. F. G.

Place the mirror face downward on a table and clean off the spot to be silvered by rubbing it with a small puff of absorbent cotton. Now spread over the spot a piece of tinfoil a little larger than the area to be repaired, and after spreading out smoothly let fall on the center of it a drop of metallic mercury, then with a bit of chamois rub the foil until it becomes brilliant. Now place over the new amalgam a sheet of smooth writing paper and on it pile books of similar weights. Leave it overnight. The amount of weight needed is not great—just sufficient to keep the new amalgam in close contact with the glass. The amount of mercury should correspond as nearly as possible to three drams to the square foot of surface to be resilvered.

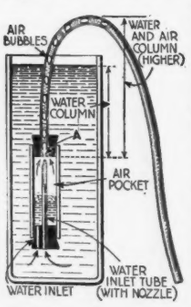
PARADOXES OF SCIENCE

Water Runs Uphill

YOU know, of course, how the ordinary siphon works, but do you know how to make a self-starting siphon in which the water apparently starts to run uphill of its own accord?

In the illustration below we show a self-starting siphon. When the tube arrangement is lowered into the jar, water rushes in at the two openings in the lower rubber stopper. The air is pushed out by way of *A*. But the water that passes up the small nozzle from the center opening gets pushed in by the rush of air and the result is a bubble of air and a bubble of water all along the tube as shown in the diagram.

Now consider point *A*. Acting downward on it there is the combined weight of all the air bubbles and all the water bubbles. But acting upward on it there is the weight of a column of water extending from the surface to the point *A* marked in the drawing. If the point *A* is lowered far enough under water, the water column will be heavier than the air and water column combined. The air and water column will then move up and over, gradually removing all the air from the upper tube. Thus, after a while, you have all the necessary working conditions of the usual siphon.



The Color of Gold

What is meant by white gold? What, actually, is meant by "18 karat" or "14 karat" gold ?—J. P. I.

Solid gold is considered as being 24 karat. Therefore, 18 karat gold is gold containing six parts of other metals. The color of gold objects depends on the metals that are mixed with it. Thus if silver is melted with gold, the result is a light, almost white, gold. If copper is added to the pure gold, the product is known as "red gold."

The exact formula of so called "white gold" is a trade secret.

Blotting Paper Substitute

How can I make the white plaster forms that are now frequently used in place of blotting paper?—M. O.

A solid substitute for blotting paper can be prepared by mixing 14 parts by weight of plaster of Paris and two parts of potato flour with sufficient water to produce a plaster paste. Pour or press into a suitable mold. When dry, the surface makes an admirable blotter.

How to Cement Celluloid

What can be used to cement two celluloid articles?—F. A.

The collodion solution sold commercially under a well known trade name will be found effective as a celluloid cement. Another cement can be prepared by mixing the following ingredients: Camphor, one part; alcohol, four parts; dissolve and add an equal quantity, by weight, of shellac.

The Sources of Radium

What are the principal ores from which radium is extracted? What is the life of radium?—N. I. G.

Pitchblende, carnotite, and autunite are the principal sources of radium. The radiating period of radium is computed to be about 2500 years.

What Is Your Question ?

Every reasonable specific query in the field of general science addressed to this department will receive a prompt reply. Legal and medical queries cannot be answered.

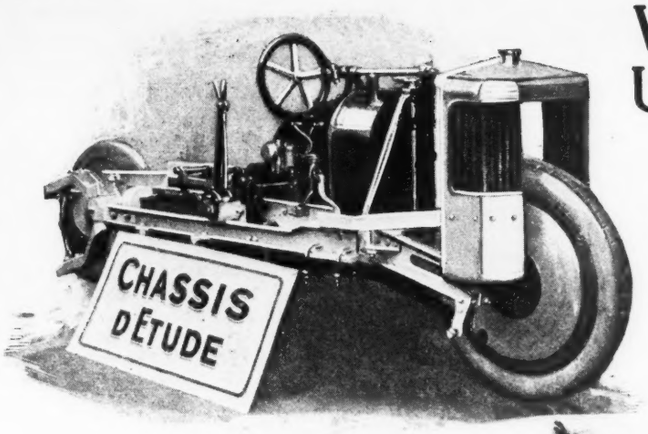
A stamped self-addressed envelope must accompany each question, but the writer's name will not be published, if he so requests.

Address the Editor, Popular Science Monthly, 225 West 39th Street, New York.

Electric Trouble-Detector

What Paris Has to Show Us in the Line of Speedy Cycle Cars

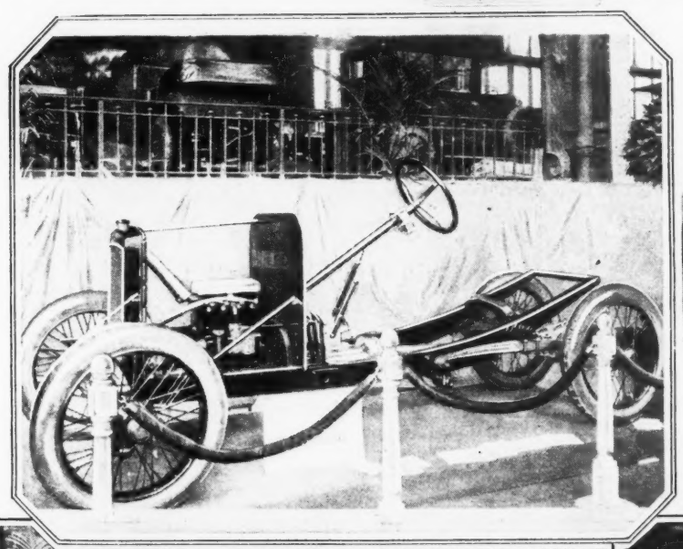
COMBINING lightness, speed and economy, the small car is becoming extremely popular. How it is establishing itself in England by remarkable speed records was graphically described in the February issue of POPULAR SCIENCE MONTHLY. On this page are the latest cycle models exhibited at the recent Paris auto show.



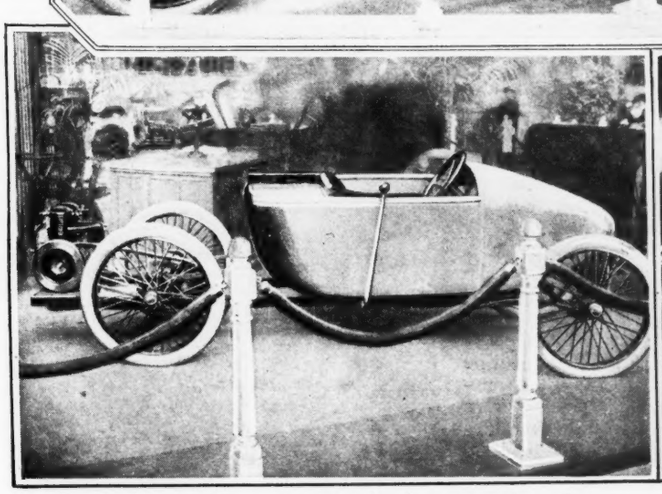
Gyroscopic two-wheeled cycle cars were exhibited in experimental form. The gyroscope is attached to the rear wheel, its effect augmented by a balancing force derived from the large, heavy wheels. The chassis is by Giesberger. Practical use for the model illustrated above may be found on the narrow roads of the French colonies

In the latest scooters from the Otobiron shops the three and a half horsepower motor is under the saddle. The frame is larger and heavier than in former models, with a more comfortable seat. The pedals control brake and accelerator; otherwise the machine is operated from the hand grips like a motorcycle

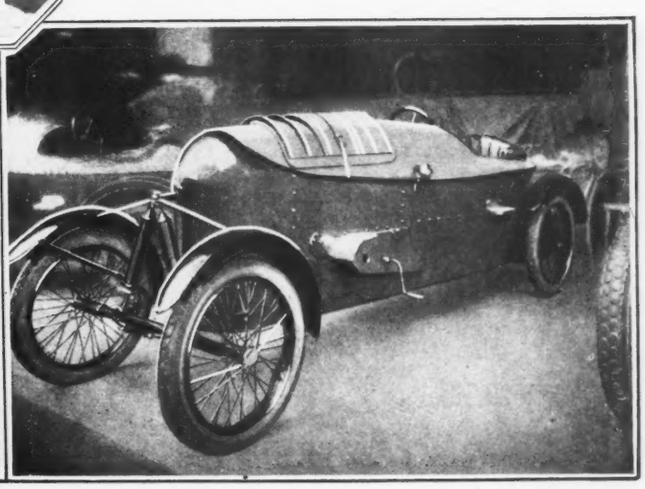
The M. A. S. E. cycle car illustrated below, has a curved chassis frame, bending upward over the rear wheels to permit an improved spring attachment. The drive is exactly the same as that of standard automobiles, and a gear shift is introduced in spite of the small power of the motorcycle motor propelling the car



With a compact one and three quarter horsepower aviation type engine attached to the front wheel, the new Peugot motorbicycle shown above can make 20 miles an hour. The front fork is strengthened—the only change necessary



On the Weler cycle car the engine has been taken from the hood and mounted on a platform extending back of the rear wheels. This greatly simplifies the transmission problem in the light car, but exposes the six-horsepower engine



The Jacquemont cycle car is air cooled and carries a five-horsepower motor cranked from the side. An unusual suspension of coiled springs in dustproof sleeves is utilized for the front wheels, reducing the unsprung weight

© K. & H.

Triplane at Paris Show Has Novel Wing Design

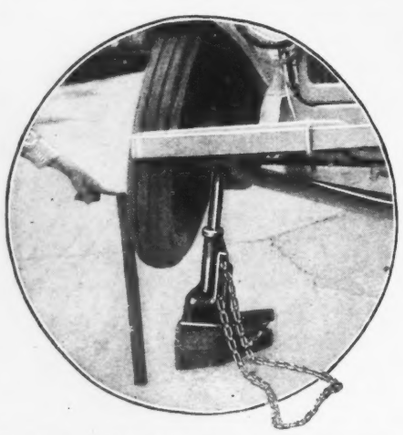
A TRIPLANE, exhibited at the recent Paris aerial show, was pronounced a unique departure from established lines, particularly in wing arrangement. The lowest plane is the largest and the upper the smallest. The struts are so arranged that they form a system of triangular trusses that make bracing wires unnecessary.

Instead of being mounted in the fuselage, the engine is in a separate "power egg" hung between the top and bottom planes. The cockpit for the pilot is in the fuselage, just behind the wings, and slightly below and to the rear of the engines. The machine is a hydroplane, and an attempt seems to have been made to add to the lift of the wings by altering the conventional lines of the boat hull.

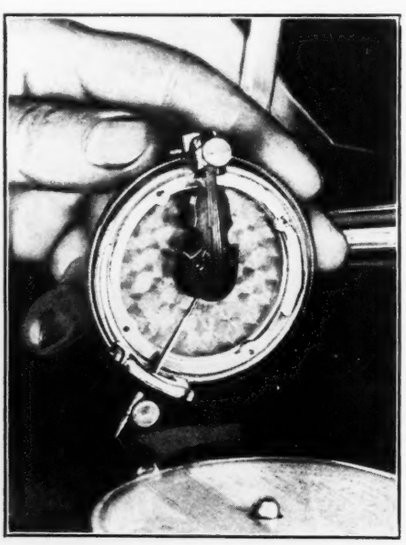
Pivoted Front Spring Relieves Strain on Truck

A TRANSVERSE front spring pivoted at the center and shackled to the axle at each end has been adopted on a one-ton truck model produced by an American manufacturer to minimize frame distortion and give increased flexibility to the running gear. Rough roads strain such a chassis very little, for with spring suspension of this type a front wheel can be raised more than a foot from the ground while all other wheels rest on the road.

Additional bracing for the front axle is provided by two diagonal radius rods shaped like a wishbone. The ends of the rods are attached to the axle at each side near the wheels, and the butt of the wishbone terminates in a ball joint that fits in a socket on the under side of the transmission case. Even the bracing is perfectly flexible and will accommodate itself to an uneven road, saving truck and driver many jolts.



One front wheel can be raised a foot above the other without frame distortion



Tiny Violin Softens the Tone of a Phonograph

MADE in the shape of a violin only for the sake of appearance, this device modulates the tone of a phonograph directly at the point of reproduction, so that the tone is softened without being muffled by throttled openings.

The attachment is clamped on to the rim of the reproducer, and works by slightly reducing the vibration of the mica diaphragm. The tonal quality of the music is unaltered, and the sound produced can be reduced until it is safe to play a phonograph in a city apartment after twelve at night without fear of reproaches from the police or sarcastic neighbors.

MOST "French briar" pipes actually come from Corsica. The Sicilian briar-root is considered the best.

Electric Trouble-Detector Fits in Pocket like a Pen

RESEMBLING a fountain-pen in size and shape, and readily carried in the pocket, a new trouble-detector for electric repairmen contains a polarity indicator that needs no connecting into the circuit to be tested, a compass that can be used in any position, an alternating-current detector, and a frequency meter, with a range equal to a standard instrument.

The detector is useful in locating grounds and short circuits without cutting or disconnecting wires. Similarly, it is adapted to quick location of faults in connections and windings of generators and motors. Noises that would interfere with devices depending upon sound do not bother the user of the new instrument, since indications are visual.

Disconnecting of wires is unnecessary with this pocket detector, which is tuned to the frequency of the current by means of an adjusting button and indicator

The detector is a reed device operating on the resonance principle, and tuned to the frequency of the current to be detected. For this tuning an adjusting button is moved to a position indicating a frequency slightly above the supposed frequency of the current tested and then moved forward slowly until a red ring moves forward with a positive movement characteristic of the alternating current. The button position then indicates frequency of the current.

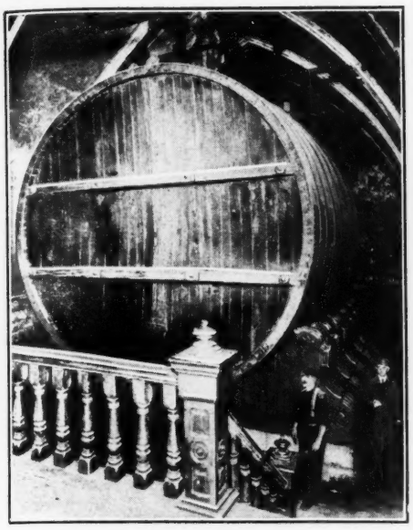
Air Springs for the Bicycle Saddle Give Riding Comfort

WITH this saddle the bicyclist literally rides on air. The flexible springs beneath the saddle are supported on two egg-shaped cushions filled with air under pressure. The saddle is inflated like a tire, and is made of strong fabric lined with rubber.

The springs of the inflated saddle are supported on two air-filled cushions

the light car, but exposes the six-horsepower engine

for the front wheels, reducing the unsprung weight



Largest Wine-Cask Will Be Sold as Old Lumber

PROHIBITION is responsible for the recent decision to sell the largest wine-cask in the United States, a monster wooden storage vat once one of the "sights" of Toledo. The cask used to hold several hundred barrels of wine, and when first built cost more than $4000.

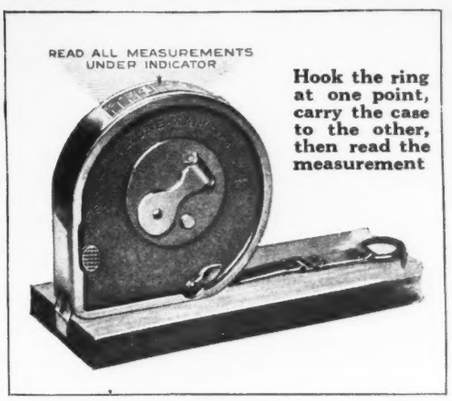
Its size necessitated the erection of a special building to cover it. As no use can now be found for either cask or building, both have been abandoned and will be sold as old lumber.

POISON baits are effective against wolves, even old and wise ones, says the Department of Agriculture. The general impression that wolves cannot be poisoned is declared to be erroneous.

One Man Can Handle This Steel Measuring-Tape

A HOOK on the end of the tape, and an extensible lug in the case, take the place of the other man who used to be necessary when measurements were taken with a steel tape. With this invention one man does the whole job.

The measurement is read under the indicator on the top of the case. A cam-lock retains the reading after it is taken, eliminating this source of error. A sharp triangular point like a heavy thumbtack, attached to the ring, can be hooked over the end of a board, as illustrated, or pressed into the wood. The operator walks to the other point to be measured and places the



Hook the ring at one point, carry the case to the other, then read the measurement

right-angled section of the case against it. The reading is taken at a glance.

This right angle in the case also makes it possible for one man to use the tape in taking interior measurements, such as the width of windows, or outside measurements, such as the height of doors. The extension in the back of the case is hooked over a door, and the tape drawn to the bottom.

Phonograph-Movie Machine Plays Tunes for Pictures

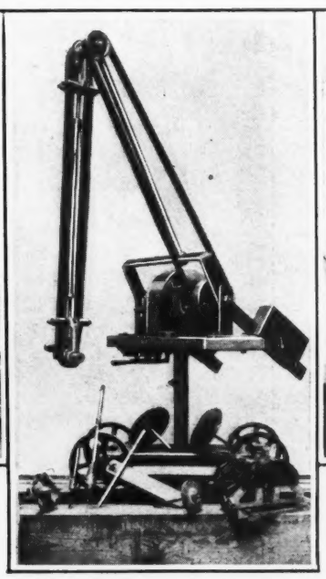
A COMBINATION phonograph and motion-picture projector that plays appropriate music as the film is being shown has been invented by A. L. Edminson, of Los Angeles, Calif. After eight years of experiment he has combined the two machines into a cabinet slightly larger than that of the standard phonograph. The upper part contains the phonograph; the lower a motion-picture projector.

The films are exhibited on a silk screen, measuring 18 by 22 inches, which is placed behind the doors of the sounding-box. It is claimed that the pictures are projected clearly enough to be seen by an audience 40 feet away.

Little change has been made in the phonograph, except that the speed governor of the record also controls the rate at which the film is displayed. Similarly, an adjusting clutch starts the record and the film simultaneously. The film is placed in a fireproof magazine, passes through a fireproof gate, over an adjusting sprocket and thence loops downward through the lens gate and back through the release sprocket. After exposure the film rewinds automatically. A cord and plug fit an electric-light socket for power and light, and a system of multiple mirrors gives a fairly large focal projection length in a small space. The illumination of the screen is so intense that the films can be exhibited in broad daylight.

Woodworkers' Tool Resembles Dentist's Drill

The plane attachment carries an assortment of cutters



With this power tool, boring holes is no longer a drudgery

CONSTRUCTED along the lines of a dentist's drill, a new flexible power tool for carpenters and cabinetmakers has a universal chuck and a set of attachments that make it practically the equivalent of a well-equipped woodworking shop. An electric motor is pivoted on the bench, and provides power by belts working on two jointed arms balanced by a counterweight. The arms swing on universal joints, so that the work can be approached from any angle.

By inserting a bit-stock or a screw-driver into the chuck, the carpenter can bore holes or set screws. Rough sawing, both rip and cross cut, can be turned out with two small circular saws, and an emery grinding-wheel can be employed.

The most novel attachment, for such a small power unit, is a plane stock with an assortment of milling cutters that makes it possible to do power planing, dadoing and rabbetting at the bench.

Walking-Stick Supplies a Light for the Smoker

A CIGAR-LIGHTER in a walking-cane is a novelty that is being introduced in France. The lighter is operated by compressed air.

A long steel rod attached to the handle and extending into the hollow of the cane carries a briquette of highly inflammable material, the chemical composition of which is secret. When the handle is thrust into the cane quickly, the air compression is said to ignite the composition. The substance glows like a pocket light. It is extinguished by thrusting back the steel tube.

Double-Headed, Four-Eyed Calf Eats with Both Mouths

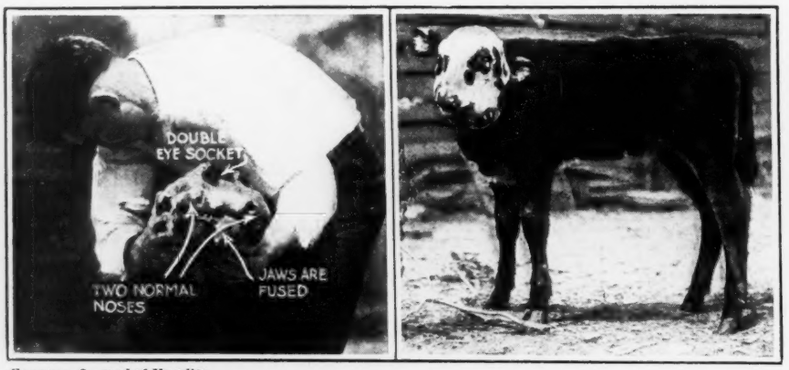
MOST double-headed calves are stuffed; but on the farm of Edd Ellis, at Arkansas City, Kans., is one so much alive that it eats with both its mouths! In fact, the animal seems to find that two heads are fully as useful as one.

The body of the calf is normal, but there are two complete heads, with two noses, two mouths, and four eyes. The two middle eyes are set in one socket, forming a double eye; but there are two eyeballs, quite independent, with inner surfaces in contact. These middle eyes seem to have atrophied, and the animal sees only with the two outer eyes, one on the side of each head. Since the forehead is abnormally broad, the calf cannot see straight ahead. During the first two weeks of the calf's life the middle eyes seemed fairly normal. Later they began to turn white and finally became covered with a scaly layer. Each of the eyeballs has an independent movement.

The animal eats with either one of its mouths, depending upon the side from which food is presented. While it seldom eats with both at once, it can do so, as the muscles are practically independent.

The definite causes of such monstrosities are not known, but it is found that in almost all cases they are accompanied by very irregular formations of the parts concerned. Even in this case, although an unusually perfect one, the fused jaws are somewhat abnormal.

It is evident that the animal has two brains, but whether its movements are controlled from both in unison, or whether one of the brains has atrophied, will not be known until post-mortem examination can be made.



Courtesy *Journal of Heredity*

So far, the calf has managed to enjoy life with two mouths, two noses, four eyes, and probably two brains

Truck Is Lowered, Head First, Down Hundred Foot Shaft

IN order to lay a cable in a tunnel being constructed below the East River, the New York Telephone Company recently found it necessary to lower a five-ton motor truck, head first, down a 100-foot caisson shaft. Although there was never more than three feet of clearance in the shaft, the truck reached the floor of the tunnel safely two hours after it began the descent.

This unusual feat was undertaken because no approaches to the tunnel had been dug, no rails were in place, and no other motive power was available for laying the cables. Delay in placing the cables until these facilities had been installed by the contractors would have meant at least a year's delay in adequate telephone service in the suburbs.

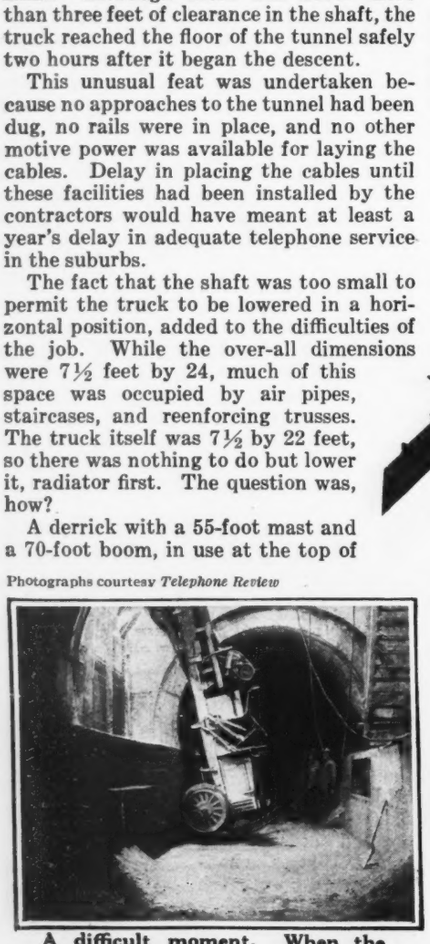
The fact that the shaft was too small to permit the truck to be lowered in a horizontal position, added to the difficulties of the job. While the over-all dimensions were 7½ feet by 24, much of this space was occupied by air pipes, staircases, and reenforcing trusses. The truck itself was 7½ by 22 feet, so there was nothing to do but lower it, radiator first. The question was, how?

A derrick with a 55-foot mast and a 70-foot boom, in use at the top of the shaft, supplied the answer. The truck was drained of gas, oil, and water; slings of wire rope were placed about the rear axle, and it was hoisted into the air and lowered like a load of earth.

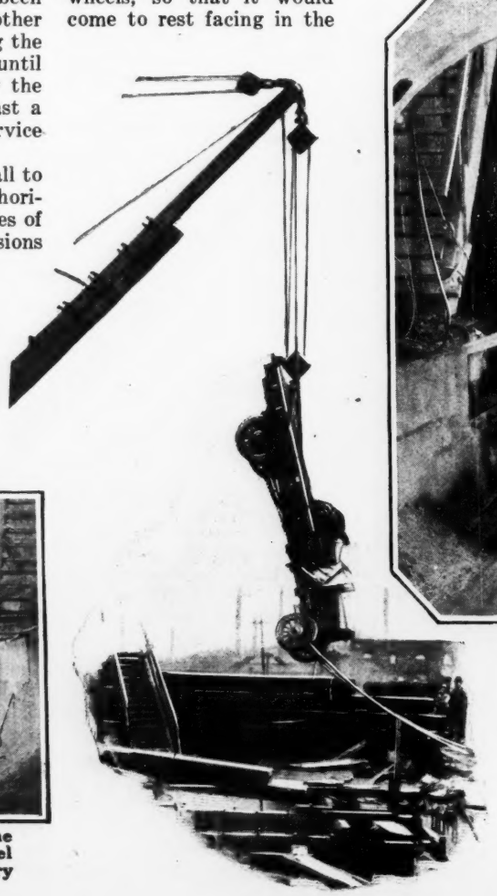
The greatest difficulty was encountered after the front wheels of the truck reached the floor of the tunnel. At this point it was necessary to give the truck a quarter turn before lowering it on all four wheels, so that it would come to rest facing in the proper direction. There was a space less than 11 feet wide in which to make the turn, and the clearance was measured in fractions of an inch.

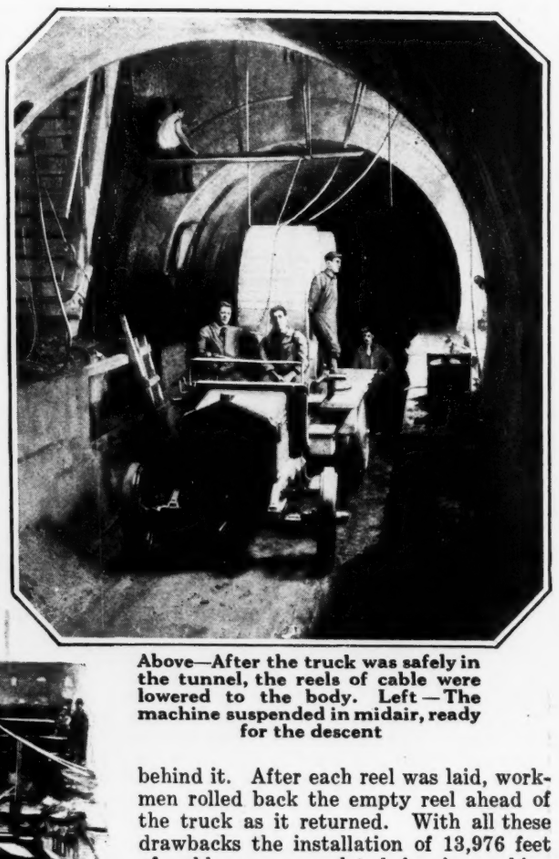
As soon as the truck was on the floor of the tunnel, refilled with gas and oil, the reels of cable were lowered and placed on the body. The machine then backed through the tunnel, paying out the cable behind it. After each reel was laid, workmen rolled back the empty reel ahead of the truck as it returned. With all these drawbacks the installation of 13,976 feet of cable was completed in six working hours. Without the assistance of the truck, the job would have been impossible.

Photographs courtesy *Telephone Review*



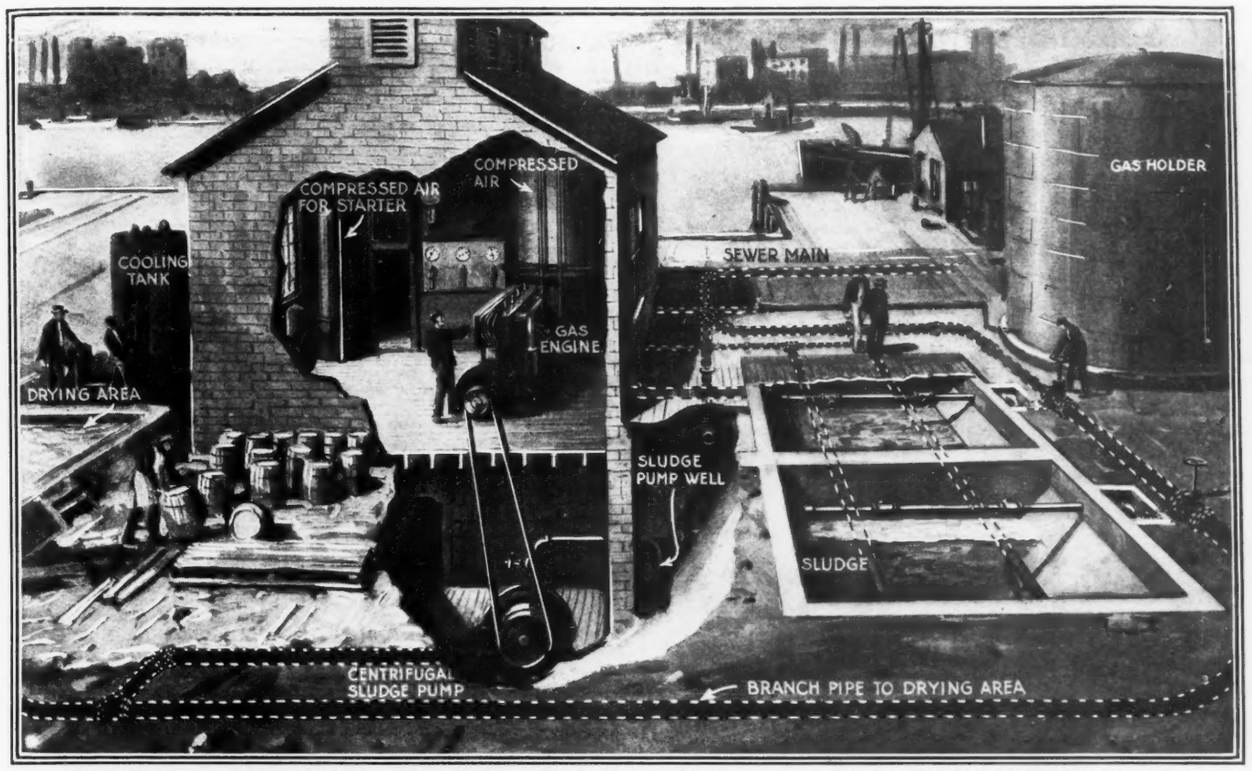
A difficult moment. When the front wheels reached the tunnel floor, a quarter turn was necessary to place the truck in position





Above—After the truck was safely in the tunnel, the reels of cable were lowered to the body. Left—The machine suspended in midair, ready for the descent

Gas from Sewage Waste Runs City Power Plant



How the sewage disposal plant at Birmingham, England, supplies its own power is described in the illustration. Gas from the sewage drives an engine of 20 brake horsepower, which operates a centrifugal sludge pump

SEWAGE that costs large cities tremendous sums each year can be turned into a source of power equivalent to thousands of tons of coal! The waste now dumped into rivers or shipped to sea may be used to run factories or to light buildings!

That conversion of sewage into power is possible has been proved conclusively by the city of Birmingham, England. There a suction gas engine of 20 brake horsepower has been successfully driven by the gases given off by sewage sludge.

On the basis of the Birmingham experiments, an American city that must now pay for the disposal of 400,000 tons of sewage sludge a year might produce 320,000,000 cubic feet of gas suitable for heat and power, or, in terms of energy, 16,000,000 horsepower hours at 20 cubic feet per brake horsepower.

The apparatus for producing gas from sewage consists of two sludge digestion tanks in which the sewage is allowed to ferment. The gases given off are composed of from 25 to 75 per cent of methane, or marsh gas.

A gas engine of the usual type will run on sewage gas without adjustment of the valves. Sewage gas has a higher calorific value than some illuminating gas, averaging about 650 thermal units to the cubic foot, as against 550.

The Birmingham engine runs about six hours a day and is used to operate a centrifugal sludge pump that moves the wet sludge from the gas-generating tank to the drying grounds. In this process a small proportion of the waste material produces enough power to run the pumps of the sewage disposal plant. If all the material were used, there would probably be enough gas available to light the city.

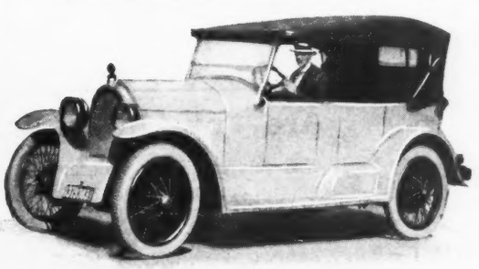
No Axles nor Chassis Frame in New Joltless Auto

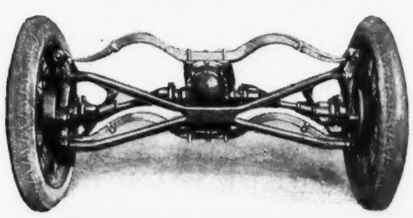
NOW comes the axle-less automobile, with the claim that it will travel over the roughest roads without jarring its passengers.

Transverse springs, placed about 10 inches apart, and pivoted to vertical members that carry the wheel spindles, enable the wheels to absorb shocks and to conform to the road without transmitting appreciable jolts to the chassis. In tests the car has been driven at 50 miles an hour over roads that were almost impassable to the standard car traveling at 20 miles an hour.

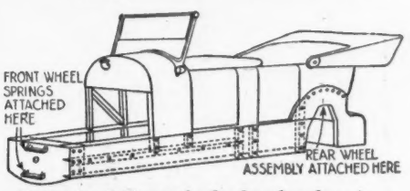
The frame, or chassis, is an integral part of the body, and is bolted solidly to it. Since all four wheels are virtually floating, the location of the transmission presented a problem that was solved simply by bolting the differential housing solidly to the frame of the car and driving the wheels by independent shafts leading therefrom.

Two springs are used on each pair of wheels. The upper spring is fastened to the frame and the lower bolted to a steel yoke connecting the wheels. The springs themselves are curved into an unusual form, and it is stated that this peculiar shape, together with the elimination of the axles, greatly reduces the unsprung weight. Unsprung weight is the portion of the car not supported by the springs, and in the new model this weight apparently has been reduced to the minimum. Except for the wheels, every part of the car is protected against road shocks.

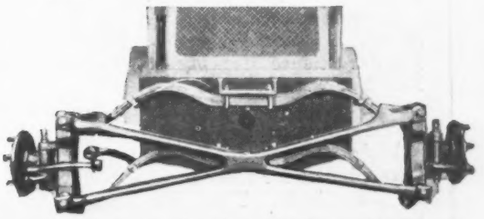




The upper spring is fastened to the frame; the lower to the wheel yoke



Bolted solidly to the body, the chassis becomes part of it. To the frame are bolted the springs and the differential housing. Above is the complete car



Attached to the frame, the springs are pivoted to members holding the spindles

Can You Help These Boys Divide Their Lunch?

Best Solutions to Sam Loyd's Puzzles Will Win $25

THREE apprentices became involved in a dispute over their luncheon arrangements that called for the arithmetical talent of the entire shop to adjudicate.

It seems that Harry and Tom were about to partake of their noontime spread, when along came John with a proposition to make it a three-handed event on equitable terms.

Harry had three sandwiches and two pies, while Tom's box yielded three sandwiches and three cakes. John had no comestibles to contribute, so it was agreed that the three should share equally in the spread and that John should pay fifteen cents for his portion.

They estimated that two pies were worth three sandwiches and that six sandwiches were worth eight cakes. Then came the puzzling debate as to how that fifteen cents should be divided between Harry and Tom.

Can You Check Up This Grindstone?

TWO mechanics, inventorying their stock on the eve of taking a new partner, were considering a grindstone.

"Put it down at half the cost," said one of the owners, "for I figure we have ground off half of the original bulk."

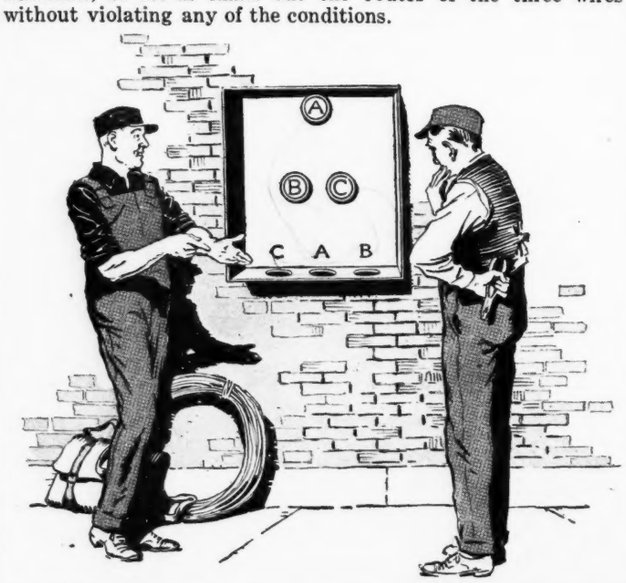
Now, if the new partner proves to be so exacting as to check up the grindstone on that basis of valuation, and finds that the circular stone has a present diameter of 15 5/7 inches, and its central hole for the shaft measures 3 1/7 inches in diameter, then what must have been the original diameter of the stone if its present bulk represents 50 per cent? Of course, that hole for the shaft means a reduction from the bulk.

Here's a Practical Wiring Problem

THE electricians below are figuring out the best way of introducing three wires into that switchbox and observing certain conditions, which are these:

The wires must not cross or come in contact within the box, yet the wire that enters at opening *A* must connect with post *A*; the wire entering at opening *B* must connect with post *B*, and the wire entering at opening *C* must go to post *C*.

To string the wires without crossing them or allowing them to touch appears to be rather an appalling proposition at first inspection, but it is really not so difficult if a little ingenuity be exercised; so let us mark out the routes of the three wires without violating any of the conditions.



$25 for the Best Answers

A FIRST prize of $10 will be awarded the reader who sends in the best set of correct answers and analyses covering the three problems on this page; a second prize of $5 for the next best set; and ten other prizes of $1 for the ten next best sets.

Answers must be received not later than March 1, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y.

As a special convenience to readers, answers to the February and March puzzles will be published in the May issue, and names of prize winners for these months will appear in the June issue. Thus, the answers to the February puzzles will appear one month earlier than previously announced.

Are You One of the Star Puzzle Fans?

PUZZLE solvers who are deserving of special commendation for their work in answering Sam Loyd's November brain twisters include:

H. T. Shrum, Oshkosh, Wis.; Bessie B. Barkley, Kansas City, Mo.; W. R. Doyle, Aberdeen, Wash.; J. P. Owens, Graham, Texas; K. M. Bard, Ripon, Wis.; Orin C. Watkins, Salem, Ore.; Isabelle Swanlund, Superior, Wis.; W. S. Chapin, Muskegon Heights, Mich.; W. H. Keller, Emporia, Kans.; M. N. Quade, Urbana, Ill.; James A. Conklin, Milton, N. Y.; Edwin Farmer, Honolulu, Hawaii; I. Larson, San José, Calif.; C. C. Meredith, Moatsville, W. Va.; D. O. Newton, Santa Rosa, Calif.; Herbert C. Pepper, London, Eng.; Stella M. Hinz, Madison, Wis.; J. O. Wood, Muskogee, Okla.; K. S. Patrick, Victoria, B. C.; A. J. Asmussen, Stettler, Alta.; Karl J. Elk, Quincy, Ill.; W. C. Mallette, Albany, N. Y.; John Pierson, Melrose Highlands, Mass.; B. J. Fenton, Oneida, N. Y.; Frank H. Broome, Jersey City, N. J.; S. Boyd Calkins, Durango, Colo.; Jack Gordon, Bridgeport, Conn.; Caroline B. Boucher, Millington, N. J.; R. D. Wirt, Daytona Beach, Fla.; Jason Crain, Wallingford, Conn.; A. K. Walton, New York City; R. C. Hitchcock, Middletown, Conn.; P. A. Judd, Portsmouth, Ohio; R. J. Stephens, Rosedale, Kans.; David S. Keiser, Phila., Pa.; Haig Kapigian, Camden, N. J.; H. H. Hildebrandt, Logansport, Ind.; Mrs. W. Hall Moss, Dayton, Ohio; M. Stinehour, Montreal, Can.; D. C. Lyle, Baltimore, Md.; F. H. Hertzler, Lancaster, Pa.; L. E. Painter, Baton Rouge, La.; Arthur Peters, Grand Rapids, Mich.; H. G. Taylor, San Antonio, Texas; Leila E. Perrin, London, Ont.; Margaret Kelly, Albany, Ore.; Hudson L. White, Akron, Ohio; Claude Robinson, Jefferson City, Mo.; Ernest K. Chapin, Muskegon, Mich.; Ejner Christiansen, Santa Maria, Calif.; J. M. Shields, Mt. Vernon, Wash.; Chas. W. Harris, Tempe, Ariz.; O. H. Barschel, Canora, Sask.; W. J. Oliver, York, Pa.; W. E. Plymire, Cordova, Ill.; C. D. Murray, Indianapolis, Ind.; James Anderson, Buffalo, N. Y.; J. A. Rafferty, St. Paul, Minn.; Morgan R. Gilbert, New York City; B. A. Long, Johnstown, Pa.; W. M. Rankel, Clyde, Kans.; T. H. MacCauley, Schenectady, N. Y.

Concrete River Wall Poured into Portable Steel Forms

BY the use of a flexible system of steel forms for placing concrete under water, a great saving in time was effected in building a concrete coffer dam at the Buffalo Terminal of the New York state barge canal. The new method was developed by Frank C. Hibbard, of Buffalo, New York.

Instead of the tedious and expensive process of driving sheet piling, then pumping out the water behind it, and erecting wooden concrete forms, huge steel forms were prepared in units 40 feet high and 20 feet long. Each unit consisted of a rigid frame, strengthened with trusses both vertically and horizontally, from which the wooden forms for the front and back of the concrete wall were suspended and supported by means of screw-jacks. The two forms, front and back, were lowered into the water by a 60-ton derrick, and the concrete was poured under water.

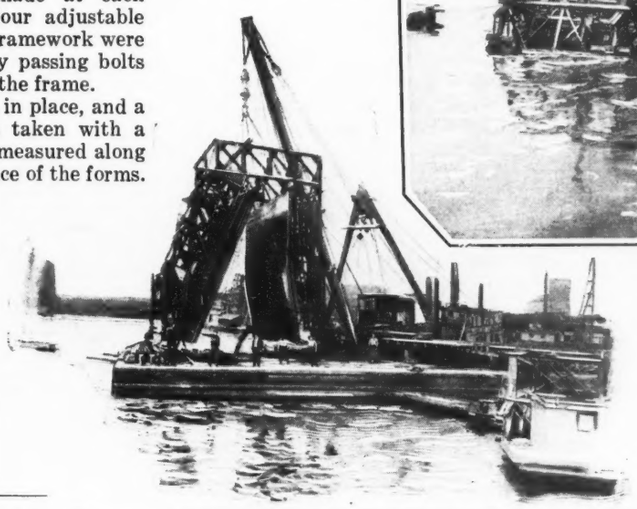
To make the bottom of the form conform to the irregularities of the bed rock, a lower wooden section was sawed to fit the rock bottom as its irregularities were ascertained by divers and a series of accurate soundings.

Before placing the forms, the mud and silt lying above the rock bottom of the river was removed by clamshell dredges. The surface of the rock was then cleaned by divers, who played high-pressure water-jets on it until the last trace of mud was washed away. Soundings were made at each corner of the form, and four adjustable posts attached to the steel framework were set at the correct height by passing bolts through a series of holes in the frame.

A raft was next anchored in place, and a second series of soundings taken with a gage pole. The depth was measured along every foot of the outer surface of the forms. The soundings were then transferred to the wooden planks on the bottom of the form by measuring from the lower edge of the steel plates and driving in nails at the proper point. Finally, the planks were sawed along these points.

"Well" holes 30 inches in diameter were left in each section so that the concrete could be tested.

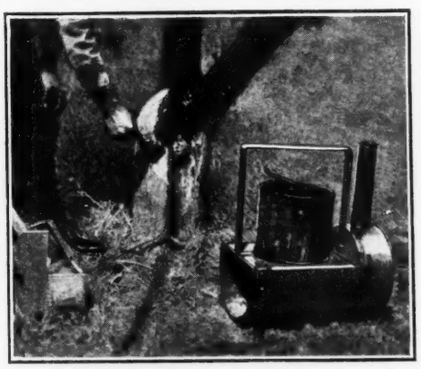
After the mud and silt had been dredged from the rock bottom of the river, the huge steel forms were lowered by a 60-ton derrick, as pictured above



At the left is shown one of the form units, front and back. Each unit consisted of a rigid frame supported by trusses, vertically and horizontally

Tree Doctor Carries Stove on His Calls

A PORTABLE orchard stove for use by the tree surgeon in treating cuts in the bark with asphaltum paint, has been invented by Paul Livingston, rancher of East Auburn, Calif. The stove consists of a semicylindrical drum of sheet iron, with a small smokestack of iron pipe at one end, and over the top a long handle by which the stove is carried from one tree to another.



The tree doctor and his stove

The top has been flattened to provide heating surface, and hereon are placed the pots holding the tar or wax that the orchardist wishes to melt in order to treat wounds he has detected in the bark.

November Puzzle Answers and Prize Winners

FIRST PRIZE, TEN DOLLARS: Calvin O. Young, 27 Grant St., Potsdam, N. Y.

SECOND PRIZE, FIVE DOLLARS: A. P. Herff, Moore Building, San Antonio, Texas.

The TEN ONE-DOLLAR PRIZES: J. T. Rosson, Burlington, Iowa; M. O. Wellman, Lansing, Mich.; W. B. Retz, Berlin, Conn.; Glen R. Bowe, Huron, So. Dak.; W. V. Hulsill, Corvallis, Ore.; Harold R. Henderson, Vancouver, B. C.; P. J. Condon, Brooklyn, N. Y.; Arthur W. Newell, Orlando, Fla.; M. S. Dechert, Cortland, Ohio; Olaf T. Gylleck, Grand Haven, Mich.

How He Patched the Roof

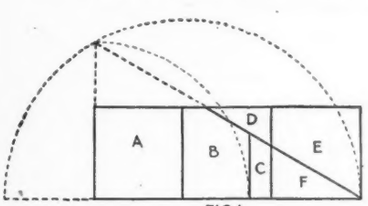


FIG. 1

THE tinsmiths dissected the three squares and combined them to form the required large square, as shown in the diagram. This is from Euclid — Book 2, Proposition 14.

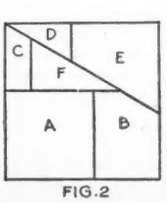
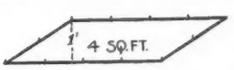


FIG. 2



Fencing the Land

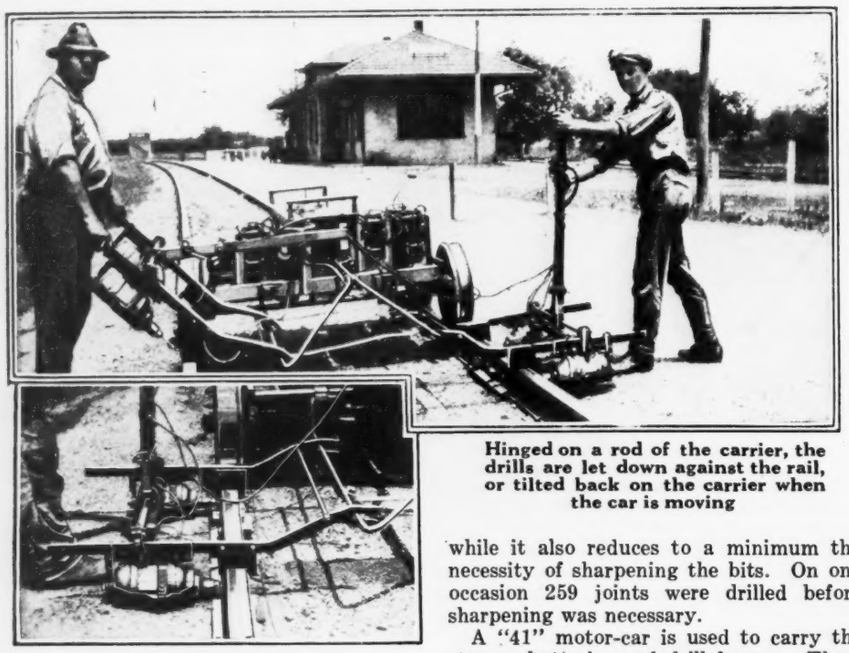
THE surveyor reduced the area of his Fig. 4, a right angle triangle, from 6 to the required 4 square feet, by turning in three of the rails and thus cutting out two squares, as shown in the diagram. Also he might have arranged the rails in the form of a parallelogram, as shown.

The above arrangements of the rails may be somewhat varied without affecting the area, and all such as were correctly presented are given full credit in the scoring.

How Far Did the Car Go?

IN the first third of the distance around the automobile track, the driver went at the rate of one mile in one minute; in the second third, one mile in 12/13 of a minute, and in the last third, a mile in 6/7 of a minute. It therefore follows that the time for his average mile for the journey was 253/273 minutes. Therefore in one hour he went 64 and 188/253 miles.

Electric Rail Bonder Drills Two Holes at Once



Hinged on a rod of the carrier, the drills are let down against the rail, or tilted back on the carrier when the car is moving

DRILLING two holes simultaneously for a rail joint, a new rail bonding machine that consists of four portable electric drills mounted on a handcar, has reduced the cost of bonding operations for one American railroad from $67.62 to $46.18 a mile.

The work of drilling holes in the rails for the insertion of signal bonding wires is usually performed by hand, and even efficient workmen occasionally break the expensive drills. The electric machine, run by storage batteries, drills two holes in 30 seconds. Both drills are fed by a hand-operated lever that gives the operator perfect control and lessens the bit breakage, while it also reduces to a minimum the necessity of sharpening the bits. On one occasion 259 joints were drilled before sharpening was necessary.

A "41" motor-car is used to carry the storage batteries and drill frames. There is an angle-iron bracket on the front of the car with a rod that supports the drill frames. This rod acts as a hinge, so that the drills may be let down against the rails, or tilted back on the carrier when the car is in motion. When a train approaches, slip electrical connections are instantly disconnected and the drill frames slipped off the rod and laid on the ground. The storage batteries may also be slipped off into the clear, so that only the light car remains to be lifted from the track—a task that can be performed by two men.

An advantage of the electric machine over a gasoline outfit is that it makes little noise while in operation.

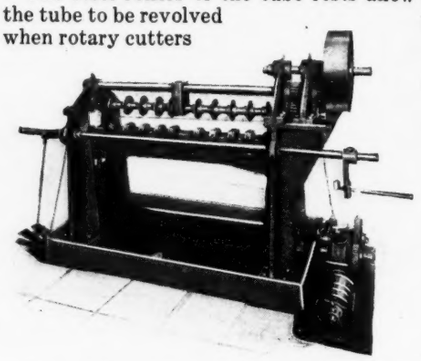
Pipe Cut in Many Lengths in Single Operation

A MULTIPLE power-driven pipe-cutter recently perfected can cut long pipe into many short lengths in one operation. The cutters are adjustable and mounted on a horizontal shaft, the axis of which is stationary.

The table located under the cutter shaft is guided by the frame of the machine for vertical movement and is raised by cams mounted on the shaft at the bottom of the machine.

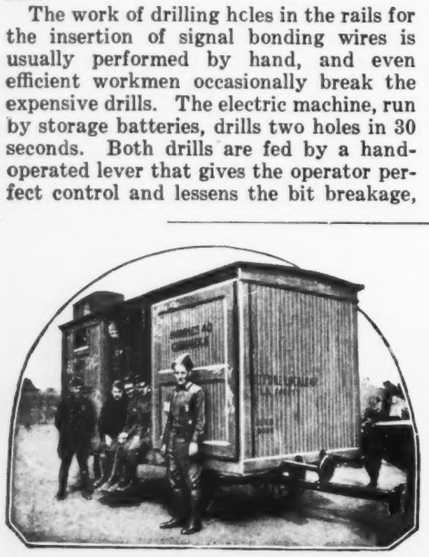
A special dovetail groove in the table carries a number of tube rests that can be positioned to correspond with the cutters.

The steel rollers of the tube rests allow the tube to be revolved when rotary cutters are used. When saws are used, the tube is held stationary on the table. A crank at the front of the machine adjusts the table height to suit the diameter of the tube and the wear of the cutters.



The adjustable cutters are mounted on a horizontal shaft above the tube rests

The machine can cut tubes up to 2½ inches outside diameter and wall thicknesses up to 5/32 inch.



"Side-Door Pullman" Recalls Days in France

A "SIDE-DOOR Pullman" almost exactly resembling the tiny French freight-cars marked "*Hommes* 40, *Chevaux* 8," in which the A. E. F. traveled over France, was a feature of a veterans' parade held recently in Los Angeles. The vehicle was three feet shorter than the car the "boys" actually used in France, but the width and height were exactly the same. Minor details were reproduced, even to the straw on the floor, the chalk marks on the door and the interior, and the inevitable flat wheel.

The diminutive size of French railroad equipment was one of the first and most lasting impressions made on the American army while in France; and the novel float was recognized as typical of French equipment by overseas men who viewed it.

Analysis of Dust Reveals Danger to Miners

RECENT analysis of dust in metal mines, in the course of improvements in ventilation to safeguard the health of workers, revealed the fact that the atmosphere is often full of fine, sharp-edged particles that cut into the tissue of the lungs and may eventually cause sickness and death.

Samples of the dust are collected by pumping air through a small tube filled with sugar. The tube is placed against the mine faces where the men work, and the pump is operated so as to suck in about a cubic foot of air a minute. This is the average amount breathed by a miner during his work, and the sugar collects about the same amount of dust that is retained by a man's lungs. Analysis of the samples shows whether the dust of the mine is dangerous and the probable effect of steady work on the miner's health.

Not until recently has proper ventilation been considered necessary in metal-mines. The most dangerous dust is produced from siliceous material such as quartz or flint. Silica is insoluble, and splits into pointed particles like tiny bits of broken glass. There may be from five to seventeen billion of such particles in every cubic meter of air when rock is prepared for blasting by dry drilling.

The use of water in the drill holes reduces the dust about 80 per cent, but this method of working is not in general use. Many miners prefer to "eat the dust" rather than take the extra trouble to protect themselves from it.

Sugar in the tube collects samples of dust when mine air is pumped through it

Swivel Rack for Fire Hose Saves Vital Seconds

SWIVEL connections for fire hose are being installed in one large oil-storage yard in San Francisco, Calif., to save every possible second in case of fire. The hose is kept in a rack of the usual type, but this is arranged so as to swing in a complete circle if necessary. The connection at the top will turn with the rack, so the hose may be led out in any direction without the possibility of a kink forming and delaying the firefighters in turning a stream of water on the blaze.

The valve for turning on the water is placed on top of the pipe, and is thus about five feet above the ground. The base of the pipe is protected by a concrete pyramid that keeps trucks from knocking down the installation.

FROTH on stems of grass, seen in early summer, is produced by an insect to protect its eggs. The insect is the "froghopper" (*Cercopidae*); not the grasshopper.

AS a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly.

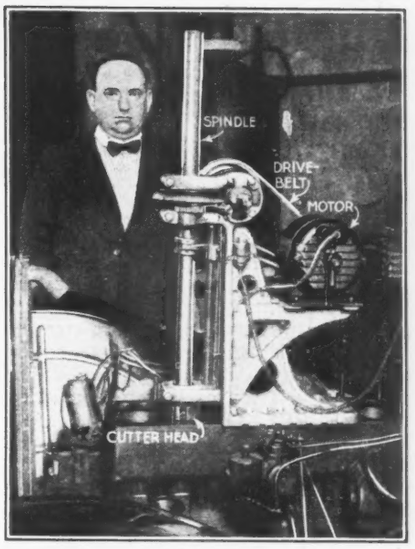
Was This the First Ship's Orchestra in History?

RECENTLY unearthed from an ancient Egyptian tomb, small clay statues of a yacht's orchestra, with their instruments, make it possible for scientists to increase their knowledge of the boat-music of 40 centuries ago.

The Egyptians believed that unless the body endured, the soul would have no dwelling or place to exist when it returned to earth, and would have to wander eternally as a ghost. It was for this reason that such care was taken in embalming the dead. Where it was inconvenient to make a mummy, small clay obituary statues were thought to serve the same purpose.

A harpist, a flutist, and a drummer made up the ship's orchestra in ancient Egypt

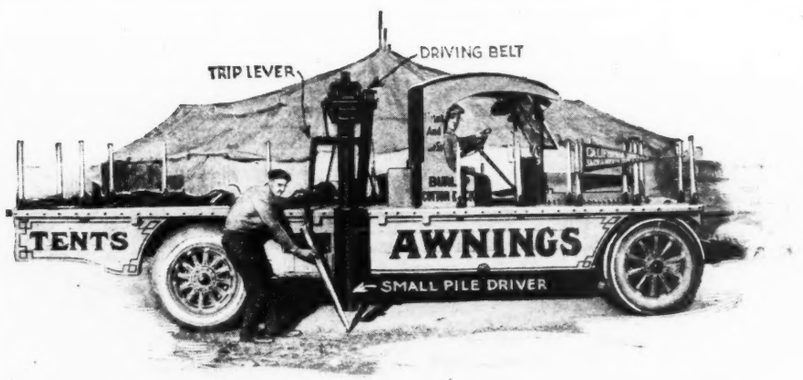
When one of these groups is found, as recently in a grave in the vanished city of Thebes, detailed description of the dress and customs of the ancients is obtained.



Cylinders Rebored without Removing Engine

REBORING auto cylinders in 24 hours without removing the engine from the chassis becomes possible with a machine whose inventor, L. S. Keeler, declares the work to be absolutely accurate. The machine has a strong frame with three bearings supporting a boring spindle an inch and a half in diamter. This spindle runs in bronze bearings that take up all wear and keep the tool in perfect alinement with the base. The motor is electric, one quarter horsepower, and a worm gear is employed to give a steady drive.

The cutter heads are constructed with a cam adjustment so that three heads will take from two and three quarters to four and one half inches. Four cutters are inserted opposite each other in the head in order to equalize the pressure of the cutters during the boring. The machine is adjusted over the cylinder and held in place by the bolts used to hold down the cylinder head, which fit into slots in the base. When the cutters are adjusted to the proper size, it is claimed that the cylinders are bored true, and with no variation between them.



Truck Now Drives the Stakes on Circus Day

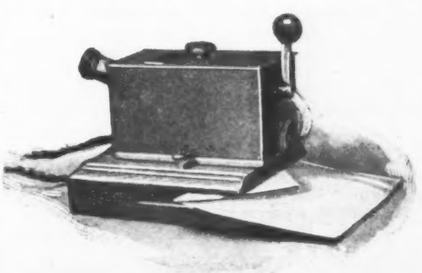
WHEN the circus arrives in town, a novel stake-driving truck now replaces the picturesque canvasmen, with their heavy wooden mauls with which they used to hammer down the tent-stakes preliminary to raising the "big top." In the heydey of the horse or road circus, four canvasmen used to gather around a single peg, and striking in rotation with 10-pound mauls, bury it three feet in the earth in a few seconds.

But the belt-driven hammer, operated by the truck engine and similar in form to a small automatic pile-driver, is even quicker than these trained crews. And since seconds count when circus tents are to be erected, the stake-driver is attached permanently to the truck that carries the stakes and the tent-poles. The duties of the canvasmen are confined simply to throwing the stakes off the wagon, and holding them upright while the machine drives them into the ground.

Electric Melter Saves Time and Sealing-Wax

MORE speed and less waste of sealing-wax are claimed for an electric sealing-wax melter that drops the hot wax on the flap of an envelope ready for stamping with the die. The wax is placed in the orifice closed by the screw-cap at the left of the apparatus, and melts almost instantly when the current is switched on.

When a lever with a knob is swung to one side, exactly the proper amount of wax to form a seal drops on the envelope. The device can be fitted on edge of table.



Just the right amount of wax drops on the envelope

First American Radio Charts Show Nation Is Now Blanketed by Wireless News and Music

You'll Find in These Maps the Broadcasts that You Can Hear

HERE is the first chance ever given the people of America to see at a glance how many important broadcasts of wireless music, news, and entertainment can now be heard in every part of the country.

After securing direct reports from dealers and amateurs in all parts of the United States, and after excluding numberless smaller stations, POPULAR SCIENCE MONTHLY has selected twenty-two points and has charted their location and "normal range" on the accompanying radio map. One or another of these stations can, with proper equipment and favorable local conditions, be heard easily and regularly in 48 states of the Union.

How to Find Your Program

To find out what radio entertainment you may normally expect to receive in your locality, simply complete in pencil on the map the circles partially indicated by the dotted lines. With the proper receiving set, and provided atmospheric conditions are right, the chances are in favor of your hearing the stations within whose radius thus charted your particular town falls.

Daily and nightly radio programs may possibly be heard over even greater distances than are here indicated, but don't forget that local conditions of all kinds may cut down the number of stations you are likely to hear in your district. In some regions you may have difficulty because of too many stations using the air at once. Before purchasing a receiving set, supplement the information given here by consulting an amateur in your neighborhood, and by requiring, if possible, a demonstration of the set by the dealer.

Finally, if the outfit you are using is one of the low-priced, crystal detector sets, remember to divide the distances shown on the map at least by 10, in order to get a reasonably accurate estimate of the radius in which any given station's broadcasts may be heard by you.

Having found on the map the cities containing radio stations that you are likely to hear in your district, you can secure from the following paragraphs definite information about these stations.

THE following stations in North Atlantic and New England states give extensive broadcasting service:

Newark, N. J.—Westinghouse Electric & Manufacturing Co. station (WJZ). Wave length, 360 meters. Program of news and concerts every evening at 8.05. Children's hour every Friday at 7.15 P.M.

Pittsburgh, Pa.—Westinghouse station (KDKA). Wave length, 330 meters. Washington Observatory time broadcasted daily, except Sunday, at 8 P.M. Government market and New York stock reports at 8.05 P.M. Special musical program, 8.30 to 9.30 P.M. Organ recital every Sunday at 4 P.M.

Springfield, Mass.—Westinghouse station (WBZ). Wave length, 375 meters. Concerts and musical programs every Sunday, Monday, Wednesday, and Friday at 8 P.M.

Medford Hillside, Mass.—American Radio and Research Corporation station (1XE). Wave length, 350 meters. News, concerts, and music every weekday evening, with sermons every Sunday.

Hartford, Conn.—Station of C. D. Tuska Co. (WQB), with a wave length of 425 meters. Concerts on Tuesdays, Thursdays, and Saturday evenings.

Union College, Schenectady, N. Y.—Irregular program of music.

Roselle Park, N. J.—Station of the Radio Corporation of America (WDY). Range 1000 miles.

IN the Southern section these stations, among others, are audible:

Washington, D. C.—Government and private stations. Correct time broadcasted at noon and 10 P.M. daily from Arlington Navy Station (NAA) with a wave length of 2650 meters. The White & Boyer station, on Tuesdays and Fridays from 7.30 to 9.30 P.M., broadcasts concerts as well as short lectures on radio.

Atlanta, Ga.—Carter Electric Co. station (4CD). Range 200 miles. Music and news service Sundays, Tuesdays, and Thursdays, from 7.30 to 8 P.M.

Dallas, Texas.—Police and fire department station (WRR). Wave length, 450 meters. Weather forecast, local news, and other information at 7.30 P.M. daily. Concerts every evening, 8.30 to 9.

Austin, Texas.—State University station (5ZU). Wave length, 375 meters. Results of athletic contests, local news.

Houston, Texas.—Numerous amateur radiotelephone broadcasting stations with ranges up to 60 miles.

How Radio Reaches You Wherever You Are

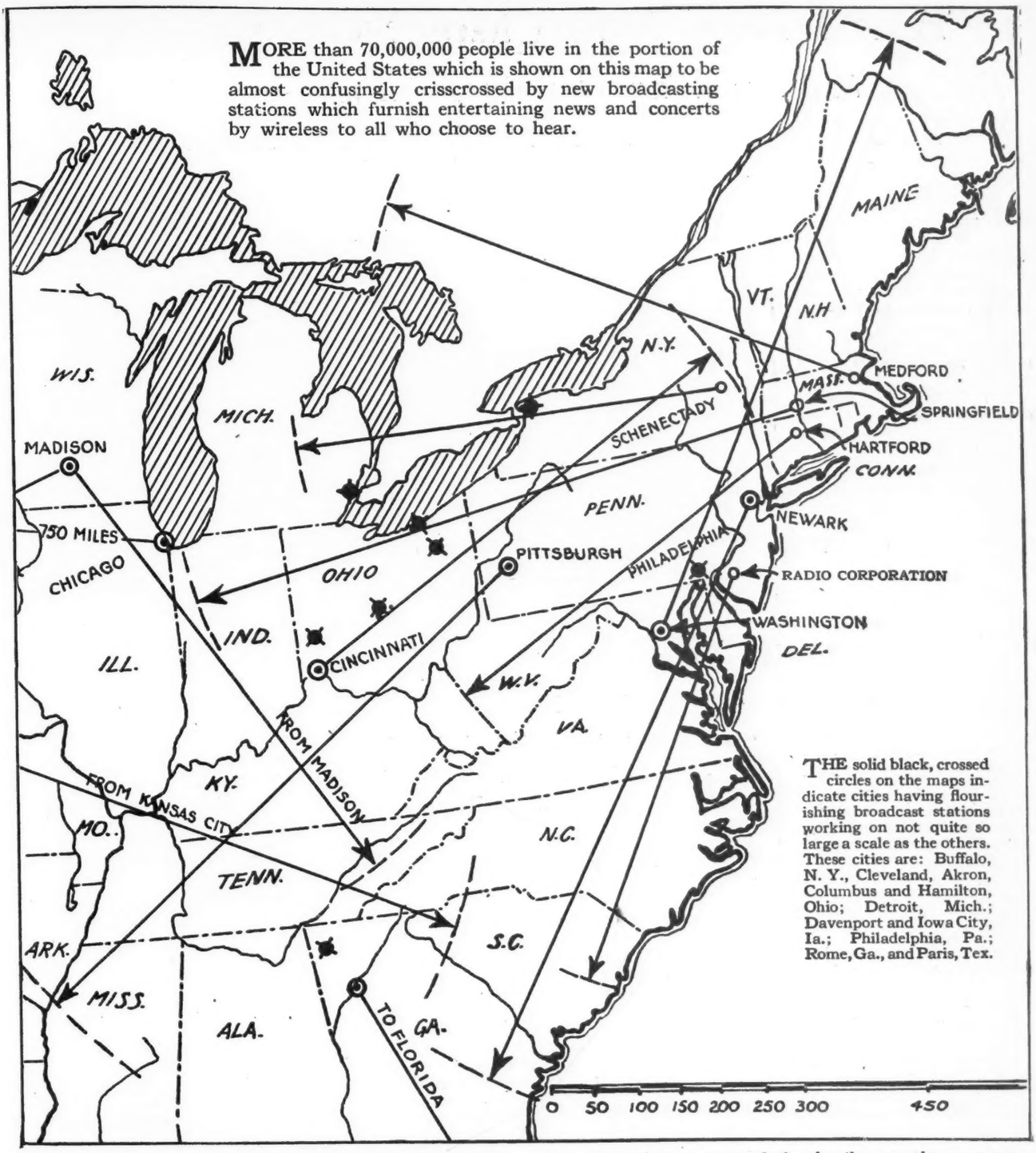
YOU have never before seen maps of the United States like those printed here. They are the first American radio charts.

Only a few months ago, POPULAR SCIENCE MONTHLY started the present national wireless craze going, with our already famous "Wake Up to Wireless!" message, written by Armstrong Perry. The nation IS wide awake to-day. Nobody can predict how many hundreds of thousands of families will soon be enjoying the most romantic recreation of modern times.

POPULAR SCIENCE MONTHLY has compiled these pioneer radiotelephone broadcasting charts in order to show just what vocal entertainment a good receiving-set can give.

If you wish further information about wireless or broadcasting stations, write to the Question and Answer Department of POPULAR SCIENCE MONTHLY.

To learn what wireless broadcasting stations you may expect to hear, complete on this map the circles partially indicated by dotted lines, using dividers. Normally you should hear from cities within whose radius, thus found, you live



One or more of the radio broadcasting stations indicated by the circles on the map can be heard regularly, with adequate equipment and favorable local conditions, in 48 states of the Union. Find on this map the cities within whose radius you are; then refer to the article for details as to the programs of these stations. Completing the dotted lines will give you the reported "normal range" of these stations, but sometimes they cannot be heard for reasons given on page 72

WORKING westward on the map, the following are the most important stations generally heard by amateurs who have reported:

Westinghouse Station at Chicago, Ill. (KVW). Wave length, 360 meters. Grand opera program every evening except Friday and Sunday during opera season. Concerts Friday evening.

Cincinnati, Ohio.—Station of Precision Equipment Co. (8XB). Wave length, 375 meters. All evening on Monday, Wednesday, and Saturday—music, vaudeville, and sport reports.

Madison, Wis.—State University station (9XM). Weather reports in code and then in voice, daily except Sunday at 12.35 P.M., with a wave length of 375 meters. On Fridays, special music at 7.30 P.M., at 800 meters. Same music at 8.15 at 375 meters. Various entertainments during remaining part of evenings at wave lengths between 330 and 375 meters.

Lincoln, Nebr.—State University station (9YY). Has widest range in that section. Concerts every evening.

Kansas City, Mo.—Station of the Western Radio Co. (9XAB). Market reports and weather forecasts at 11.30 A.M. and 2 P.M., on 375 meters. Concerts in the evening.

Denver, Col.—Station of the Reynolds Radio Company (9ZAF). News twice a day. Concerts on Sunday evening.

San Francisco, Calif.—Concerts by various commercial and hotel stations every evening in the week. California Theater to broadcast performances nightly at 360 meters.

Los Angeles, Calif.—Station in Hamburger's department-store. Reported range, 1000 miles.

San José, Calif.—Harrold Laboratories station. Range, up to 500 miles.

Seattle, Wash.—Seattle *Post Intelligencer* (newspaper). Range, 60 miles.

IN addition to the foregoing stations there are thousands of private and amateur stations scattered throughout every state having ranges up to 50 miles. Stations in Detroit, Mich., Cleveland and Akron, Ohio, and Davenport, Iowa, while less powerful than many of the others mentioned, have transmitting radii great enough in extent to enable thousands of listeners in their vicinity to enjoy the daily news reports and regular evening concerts.

"How I Keep Down Motor Car Expenses"

Readers, in Prize Winning Letters, Tell from Experience How YOU Can Cut Fuel and Repair Costs to Save Dollars

By F. A. Cuffe, New York City

Winner of the First Prize

YOU have all seen the motorist who has that uncanny faculty of always having his car ready when it is wanted. He is the fellow who really enjoys motoring. I have merely stolen his method of working, which amounts to this—*the man who anticipates trouble is better off than the man who simply remedies it after it occurs.*

The following ideas will show you why my car is ready to go on a long trip any day of the year.

The first place to look for fuel wastes is at the carburetor. I adjust the carburetor to give the leanest possible mixture consistent with satisfactory operation.

Examine All Cells

Again, if the ignition system is not right, fuel will be wasted. Many a driver decides that his battery doesn't need additional water after he has examined the first cell he happens to look into. But I examine all the cells, for it very often happens that one cell will be in bad condition or that it may be cracked so that it will require more water than the rest. And after cleaning and adjusting the spark plugs I use a jeweler's eyeglass to inspect the porcelains for elusive cracks that often escape unnoticed with the naked eye.

The valve system must also be carefully watched or it will be a prolific source of fuel waste when the valves are not seating properly.

The only way to make sure about tire mileage is to record it. I do this on a card or a slip of paper or write on the wall of the garage. When I put on a tire, I set down its number and the mileage record when it goes into service. If it comes off for a time, I make a record of the mileage to date and a new record when it goes on again.

I keep the rubber hose connection between the radiator and the cylinder jacket outlet and the pump connections covered with shellac to keep them waterproof and impervious to oil and grease. I never let the tires stand in pools of oil on the garage floor. Oil rots the rubber.

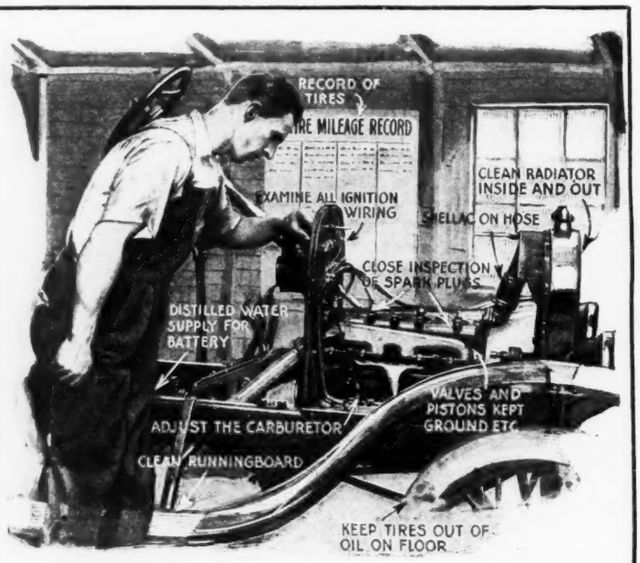
Often mud and small stones will get into the air spaces between the cells of the radiator. I remove this mud and tightly wedged stones by directing the stream of my hose through the cells from *the inside.*

To clean the inside of the radiator of rust and deposits, I pour through a hot solution of soda and water, instead of scraping.

I have found that by removing stained and dirty running boards the covering can be made to look like new simply by wiping with a clean rag saturated with kerosene. Floor boards also can be cleaned in this way.

Car Is a Friend

My friend next door invariably greets his car when he opens his garage door with—"Well, how are you this morning, old boy?" Somehow the spirit of that man gets into his car, for he has the least trouble with wear and tear. Car kindness means car service and car service means dollar saving.


RECORD OF TIRES
THE MILEAGE RECORD
EXAMINE ALL IGNITION WIRING
CLEAN RADIATOR INSIDE AND OUT
SHELLAC ON HOSE
CLOSE INSPECTION OF SPARK PLUGS
DISTILLED WATER SUPPLY FOR BATTERY
VALVES AND PISTONS KEPT GROUND ETC
ADJUST THE CARBURETOR
CLEAN RUNNINGBOARD
KEEP TIRES OUT OF OIL ON FLOOR

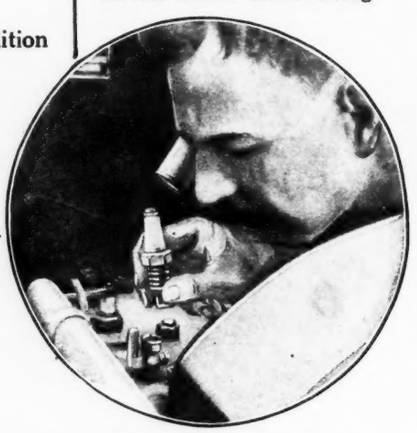
Car Kindness Means Dollar Saving

"YOU'D treat a horse well, wouldn't you?

"Why, then, should not the same condition exist between a man and his automobile?

"Who shall say that a properly cared for, a properly loved automobile may not have something that is akin to intelligence?

"Car kindness means car service, and car service means dollar saving."



"After cleaning and adjusting the spark plugs, I use a jeweler's eyeglass to inspect the porcelains for cracks"

"I Allow No One but Myself to Work on My Car"

By W. B. Bennett, Honesdale, Pa.

Winner of the Second Prize

DURING the ten years that I have been driving cars my costs have been only for tires, gasoline, oil, grease, distilled water, polishes, and painting. I have always driven these cars myself and *allow no one else to do any work on them.*

I believe that this freedom from trouble and expense is due to giving attention to the following vital factors: 1. Ignition, starting, and lighting. 2. Carburetion. 3. Lubrication. 4. Tires.

To keep down expenses on the first item, I inspect the ignition system daily, with especial care of the interrupter and distributor, making sure that all connections are tight. Every month I clean and set the spark plugs. On the starting system I check up the battery every two weeks, filling with distilled water if necessary, tighten battery supports and all connections, inspect battery wires to the starter and to the frame ground and see that the commutator on the starting motor is clean and not cutting. On the lighting system, I check up all connections once a month, making sure that the "cutout" works properly and does not stick. It is especially important that wires and connections exposed to the weather be looked after.

I have avoided a lot of trouble by equipping my cars with carburetors of a certain non-adjustable type. Every three months, I clean the gas tank and the line, look over the vacuum feed and the float needle valve. I drain the carburetor about once a week.

Lubrication I consider to be the most important of all items to keep down car maintenance. Every morning I lubricate the ignition system, and every day I give a slight turn to every chassis grease cup. I give a few drops of oil here and there where needed, especially the spring leaves.

Every 1000 miles I change the crankcase oil, and every three months I change the transmission and differential.

In caring for tires, I check inflation every day. Temperature changes make a lot of difference. I even sometimes let out a little air on a very hot day to lower the tire pressure due to heat expansion. And I have a little vulcanizer with which I repair all small cuts before they cause trouble.

"TO drive an automobile economically, the driver should be slightly what is commonly known as 'tight.' He must hesitate—and it must hurt—every time he spends a dollar; for if it doesn't hurt, he will spend many dollars without wondering how they could have been saved. To save, one must think about costs. Hence the 'close man' will think more about his car."—*R. A. Houston.*

A Real Desire to Save Must Come First

By R. A. Houston

Honorable Mention

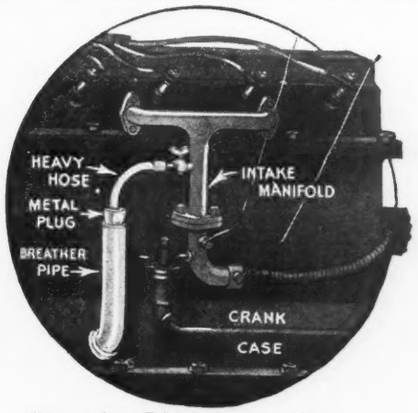
THERE are three absolute requisites to driving an automobile economically. The driver must have a fair idea of the physics of an automobile motor and chassis, since it is impossible to understand action and results without understanding the fundamental causes; he should be at least an amateur mechanic in order to make his own small repairs, and, last, he should be slightly what is commonly known as "tight."

Unless he has this last qualification, the other two are of slight importance in economical operation. To save, one must think, and thinking, in many cases, is such a task that it must be forced; hence the "close" man will think much more about the cost of his car than the easy spender.

Last spring I won a county wide gasoline consumption contest covering a period of two weeks and for a minimum distance of 500 miles. I used ordinary gasoline, and during the two weeks I increased my mileage to the gallon by one fourth. My first preparation for this contest was to see that the car was in good shape, that the brakes did not drag, that the valves were seating properly, that the motor was clean of carbon, the muffler clean and that there was no back pressure on the motor. I oiled every working part and adjusted the wheel bearings, and last of all I pumped the tires to their required pressure.

Those two weeks, while I drove, I thought always about gasoline. I never stopped behind a street car without turning off the motor, and I took advantage of every incline to use the clutch. When I wanted to stop, I turned off the motor several rods ahead of the stopping place. Now I do most of these things automatically and my gas consumption is less than that of most of my friends who drive cars like mine.

If you want good mileage, you have to go after it. It takes more than a lean mixture in your carburetor. It takes a desire strong enough to make you do the things that will save.



Simple Vacuum System Saves Fuel and Wear

By Joe V. Romig

Honorable Mention

A VACUUM system, connecting the interior of the crankcase with the vacuum influence found in the intake manifold between the carburetor and the motor valves, will effect a great saving in oil, gasoline, and motor repairs.

By this system, waste gas that slips down past the pistons is sucked out of the crankcase into the intake manifold and up into the cylinders again for use, instead of being wasted through the breather pipe. Further, as the result of a partial vacuum in the crankcase, which sucks air in, oil is prevented from leaking out under the forced pressure in the engine.

By using a portion of the incoming air, we get a good hot stream of air that will vaporize the gasoline and give better fuel results. This air also carries oil vapor, which oils the valve stems, and saves much needless wear.

The device is very simple. A brass or hard wood plug is made to fit snugly into the breather pipe, as in the illustration. Into a tapped hole in the top of the plug is screwed a rubber hose.

The other end of the hose is bound to the end of a small brass cock, screwed into a tapped hole in the intake manifold. By adjusting the cock, thereby varying the opening, the right amount of air dilution can be secured.

Do You Oil All Places that Need It?

By L. R. Fritz

Honorable Mention

I FOLLOW a schedule of regular oiling and inspection. This plan keeps down expenses by saving excessive wear on parts and by discovering the little repair stitch which, taken in time, saves nine dollars.

The Ford lubricating chart indicates about 20 things that should be oiled each 200 miles. Actually, more than twice this number need this frequent attention. When touring, I oil these things and turn up the grease cups at the end of the day's run or before beginning the next day's run. When at home I oil them a little oftener.

Under the hood I oil (7 places): timer pull rod, 2; carburetor pull rod, 2; timer, 1; fan, 1; steering gear grease cup, half turn.

Front end (12 places): spindles, 2; connecting rod, 2; steering gear connecting rod, 2; crank, 1; spring hangers, 4; springs.

Under the floor (9 places): hand brake lever, 2; brake pull rods, 2; control shaft bearings, 2; speed lever, 1; 2 grease cups, half turn each.

Rear end (13 places): brake rod, 2; supports, 2; spring hangers, 4; hub brake cam shaft, 2; grease cups, half turn each, 2; springs. This is a total of 41 places.

Besides the 200 mile oilings there are lubricating items which are needed less frequently and which, with adjustment items, are kept track of by means of a mileage chart tacked up in the garage.

Believe In Your Car

By J. Edgar Mitchell

Honorable Mention

I HAVE my local service station examine my car once every month. I avoid changing drivers and never drive over 30 miles an hour unless absolutely necessary.

I always specify the name of the oil that is most suitable for my motor, and get the amount that it requires. I never overload my car, and I believe in my car, my service station, and my instruction book.

Write the Automobile Editor About Your Motor Troubles

Why Engine Lacks Power

Q.—My engine lacks power, although the compression is good and the carburetor is in correct adjustment. I recently had the carbon removed.—R. F. C., New York, N. Y.

A.—There are many reasons why your engine may not give full power. If battery ignition is used, see that the battery is not low; if magneto ignition, see that the magnets are not weak. The breaker points should make flat contact and be in proper adjustment. The spark should be properly timed and the spark-advancing mechanism should be inspected, since lack of power may be due to a late spark. Low power may be caused by so simple a defect as a throttle that does not open all the way.

Recharging Magnets

Q.—Can I recharge magnets on my magneto with the alternating current?—A. M. H., Falls, Pa.

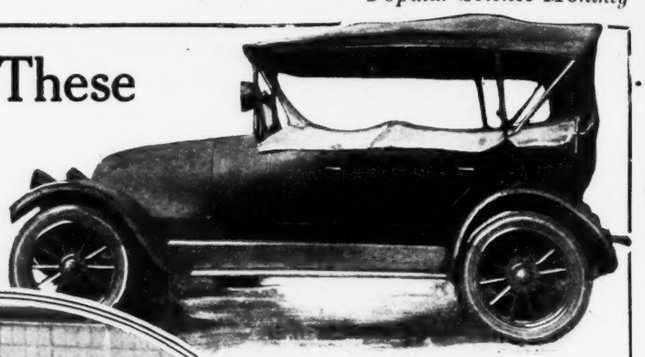
A. You cannot recharge your magnets with alternating current, and you should not attempt the work even with direct current. It is better for you to send the magnets to some shop where they are equipped to do this work.

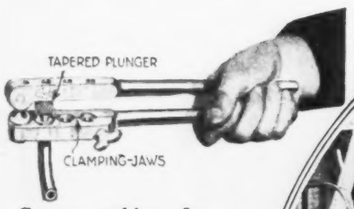
When to Use Oversize Tube

Q.—Is it necessary to use a 33 by 4 inch tube with a 32 by 3½ inch cord tire?—A. A., Rochester, N. Y.

A.—Whether a 33 by 4 inch tube should be used or not depends on the size of the cord tire. Most cord tires are considerably over size, and therefore it is frequently advisable to use an oversize tube, as you suggest. The best way to determine the size of tube required is to measure the tire. If it measures 33 by 4 inches, use a 33 by 4 inch tube. On the other hand, if it measures 32 by 3½ inches, use a tube of this size.

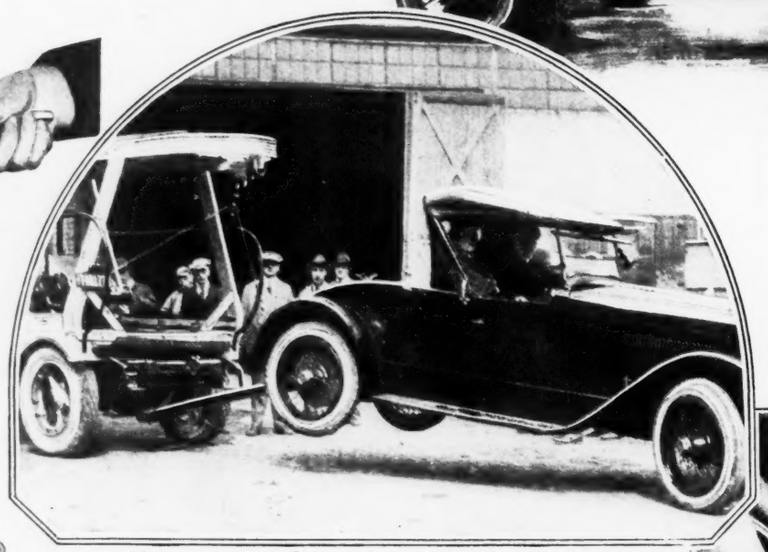
Is Yours a "Pleasure Car"? These New Tools and Fittings Add Joy to Motoring



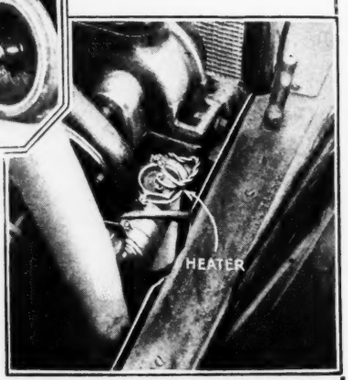


Copper tubing for conducting gasoline or oil may be flanged with this tool without being removed. One jaw is split for three sizes of tubing

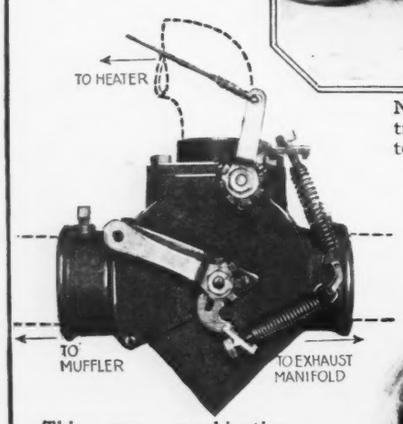
This dust apron, designed by a Chicago physician, has a special pocket that covers the steering wheel when the apron is drawn over the tonneau of the car in the garage



No matter how heavy the automobile or motor truck may be, this wrecking car is able to lift and tow it. The car is equipped with a power winch adaptable for general hoisting



A new electrical heating device, designed to keep the engine and the radiator warm during cold weather, consists of a T-shaped casting that is connected with the water pipe between the pump and the radiator. The resistance coil may be supplied with current from any light socket

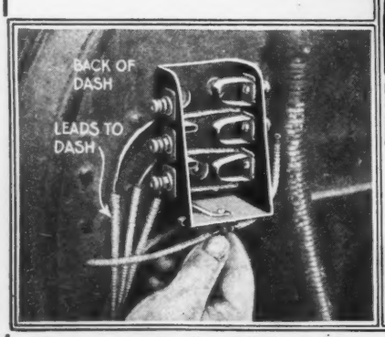


This new combination heater valve and tuning valve will either lead the hot exhaust gases into the car's heater or serve as a muffler cut-out when adjusting the carburetor

When the headlights are dimmed on meeting another car, the auxiliary lamp shown above illuminates the side of the road

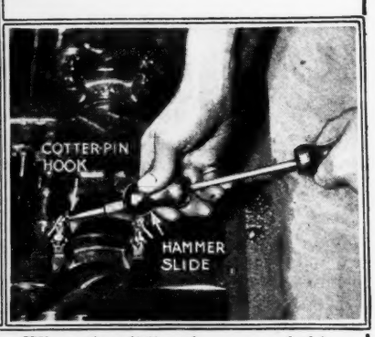
Press the plunger of this dust cap pressure gage and if the cap rises to a fixed mark, the tire is properly inflated

The spark gaps, one for each cylinder, conveniently placed under the hood, produce hotter sparks at the spark plug and insure proper ignition

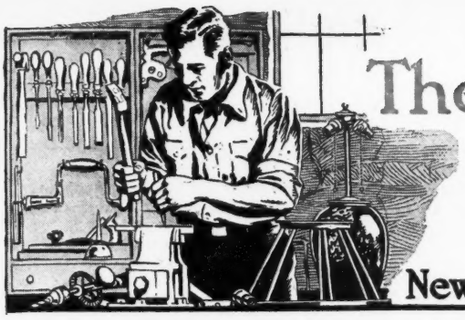


By means of colored lights, this electric dashboard device, shown with cover removed, indicates when gas, water, or oil is low

Automobile owners will find much use for the electric trouble lamp shown above. It has an electromagnet in its base and will cling to any iron or steel surface while the current is on



When the sliding hammer of this tool is pulled back sharply, the hook at the end of the rod will loosen any obstinate cotter pin



The Home Workshop

New and Useful Things for the Practical Man to Make

Electrical Timing Device Prevents Many a Kitchen Mishap

By, Oliver L. Stevens

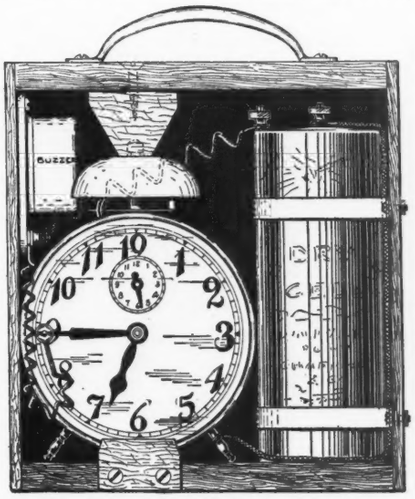
(First Prize in "New Uses for Electricity" Contest)

THIS device is designed with the idea of keeping the *genus homo* from seeing red when he sits down to breakfast and finds his eggs under- or overdone. It is also useful for timing other things for intervals of half an hour or less. By setting the contact screw over the numeral 12, the clock will buzz on the hour every hour.

In timing any operation, note the position of the minute hand and turn the glass face of the clock until the contact screw is the required number of minutes in advance of the hand. When the hand makes contact with the screw, the buzzer will operate.

A frame is made of wood, back and front open, and an ordinary alarm-clock, buzzer, and dry cell are fastened in place as shown on the drawing at the right. Remove the ring on top of the clock and drill a piece of wood to receive the post, as shown. Saw slots in the bottom piece and fit in blocks, front and back, to hold the bottom of the clock in place.

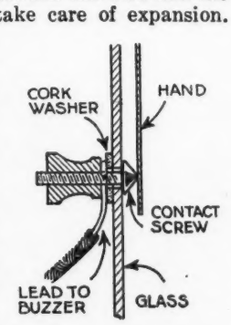
A sectional detail is shown of the glass face of the clock, in which a hole is drilled. A screw made from a standard binding-



Mr. Stevens' own drawing of the simple timing device

The buzzer gives the alarm

post is fastened in place with some kind of a spongy washer between the wire and the glass in order to take care of expansion. The wire from this contact screw is connected with one binding-post of the buzzer. The other buzzer connection is made to one post of the dry cell. It is well to make one end of this wire a slip-on connection in order that the buzzer may be disconnected when desired. The wire from the other binding-post of the dry cell is soldered to one foot of the clock.



Contact detail

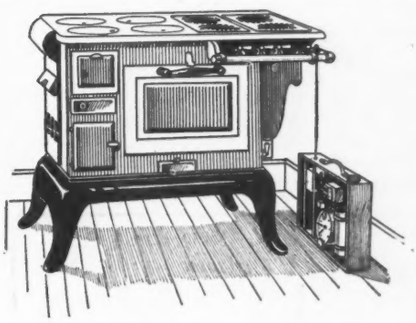
This device will soon be declared by the cook to be the handiest thing about the kitchen, but it has still further applications. The next step is to connect it with the gas-range so that it will turn off the gas.

This is done by providing a somewhat larger box than is necessary for the buzzer timing device alone and constructing a slide at one end so that a weight—in this case a piece of a bar of anti-friction metal that happened to be in the junk box—can slide freely up and down. A catch is made by bending a piece of ¼-in. round iron bar—any strap iron can be used—into a hook shape. One end is flattened and drilled so that it can swing from a block at the top of the box alongside the slide in such a way that the hooked end passes through a hole in one slide and projects just far enough to prevent the weight from dropping. Bell magnets are mounted on another block so that when they are energized they will attract the latch and thus permit the weight to fall.

The magnets are connected in the same way as the buzzer and a two-way switch permits either the buzzer or the magnets to be used, as desired.

A piece of picture wire runs from the weight up through a hole in the top of the box to a handle on the gas-range in such a way that when the weight drops, the handle is turned to the off position. In this case it very conveniently ran up over the feed pipe, where it passed through a wire "eye" or guide fastened to the pipe with friction tape, and was attached to the cock around the head of the machine screw that holds the porcelain handle in place. It was arranged to turn off only this one burner, although it could have been used for the other burners as well.

It is obvious that with a little ingenuity in attaching it, the device could be made to do many similar things. It could be ar-



The timer arranged to turn off a gas-burner

ranged either to turn off or on an electric stove or store-window lights or anything of that kind by simply placing the box under a knife switch and hooking the wire to the switch handle.

The timing device might also be used to serve as a substitute for an elaborate and expensive "program" clock, especially if the intervals to be rung were an hour apart. If it were desired to have two bells ring, perhaps one on the hour and another five minutes afterward, as in a school, two contacts could be arranged 30 degrees apart.

To ring the bell or buzzer for a longer interval, the contact should be a beveled strip thick enough so that the minute hand will make a firm sliding contact with it throughout its length. The circuit will then remain closed as long as the hand is passing over the strip.

Live Electrical Ideas

THE four best contributions to the contest on "New Uses for Electricity," appear in this month's Home Workshop.

The prizes awarded are:

First prize of $50 to Oliver L. Stevens, 116 Kirk Ave., S. W., Roanoke, Va.

Second prize of $25 to R. A. Squires, 517 W. Main St., Louisvil e, Ky.

Third prize of $15 to J. W. Fr tsch, 1525 Chew St., Allentown, Pa.

Honorable mention, R. E. Nelson, 2910 Exeter St., Duluth, Minn.

Outfit Receives Continuous Wave Radio Signals

Being the Third Article on Wire ess Receiving Sets by Arnold Holmes

SIMPLE wireless receivers and audion detectors and amplifiers, such as were described in detail in the December and February numbers of POPULAR SCIENCE MONTHLY, are capable of receiving only spark signals or modulated continuous wave signals. That involves detection alone. Figure 1 illustrates the sort of voltage across the detector resulting from detection, which is, in effect, rectification. The current in the output of the detector is as shown. The current through the telephones is the audio frequency current; that is, the frequency at which the amplitude of the radio frequency current and voltage vary. That variance is what makes spark signals and modulated signals audible by detection.

The question then arises, how are continuous wave signals made audible? Upon detection of continuous-wave telegraph signals direct current results. That, of course, is not audible in the telephone receivers except in the form of a click. In order to make continuous-wave signals audible, another frequency generated by the receiver, which differs from the received signal by an audible frequency of perhaps one thousand cycles, is impressed on the detector together with the signal. These two frequencies produce beats occurring at a frequency that is the difference between the signal and local frequency. Upon the detection of this high-frequency voltage, whose amplitude varies at an audible rate, the low frequency is obtained that becomes audible in the telephone receiver.

What apparatus is needed to accomplish this? Figure 2 is a circuit diagram of a receiver that is arranged to receive continuous-wave signals. The local oscillations are produced in the circuit L_2 C_2 by the vacuum-tube oscillator, which is of the feed-back type. Oscillations are produced in the circuit by feeding some of the amplified high frequency in the plate circuit of the tube back into the input. This is controlled by the coupling of the tickler coil (L_3) with the secondary coil (L_2).

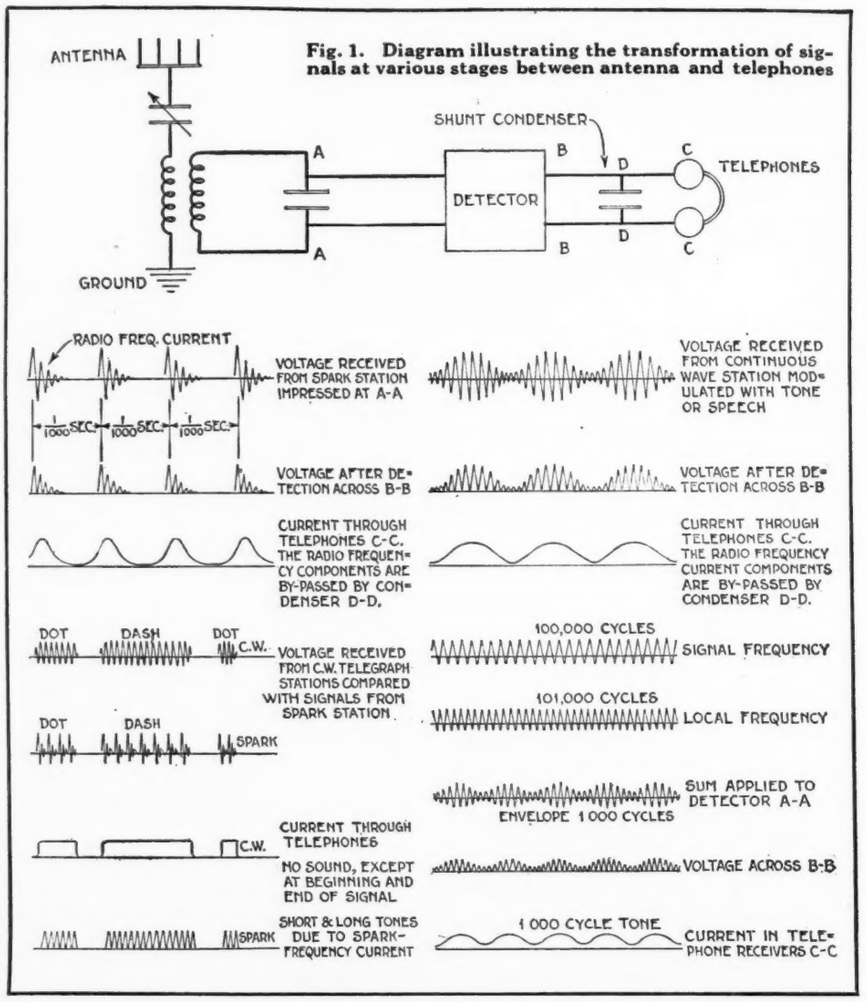


Fig. 1. Diagram illustrating the transformation of signals at various stages between antenna and telephones

A very convenient receiver for this range of wave lengths is illustrated in Figure 3 on the following page. The universal mounting shown allows the coupling to be varied between antenna and secondary circuit and between tickler coil, not only by moving the coils apart, but by actually rotating them 90 degrees with respect to each other. This provides a fine degree of variation of the coupling. By the use of honeycomb or duo-lateral coils the wave length range of the set can be made almost anything.

The size of the coils that should be used may be determined from the accompanying list of the duo-lateral coils required to give a wave-length range of from 2000 to 15,000 meters, using a tuning condenser of from 50 to 1000 micro-microfarads (.00005 to .0010 microfarads).

Primary Inductance For Antenna 400 M-mfds	*Tickler Coil*	*Secondary Inductance*
1500 to 2700 meters, coil No. 100	Coil No. 100	1800 to 6000 meters coil No. 400
2000 to 3600 " " No. 200	" No. 300	
3100 to 5500 " " No. 300	" No. 750	3500 to 11,500 " " No. 750
5300 to 9300 " " No. 500	" " "	
7900 to 14,000 " " No. 750	" No. 1250	7500 to 24,000 " " No. 1500
14,000 to 24,000 " " No. 1250	" " "	

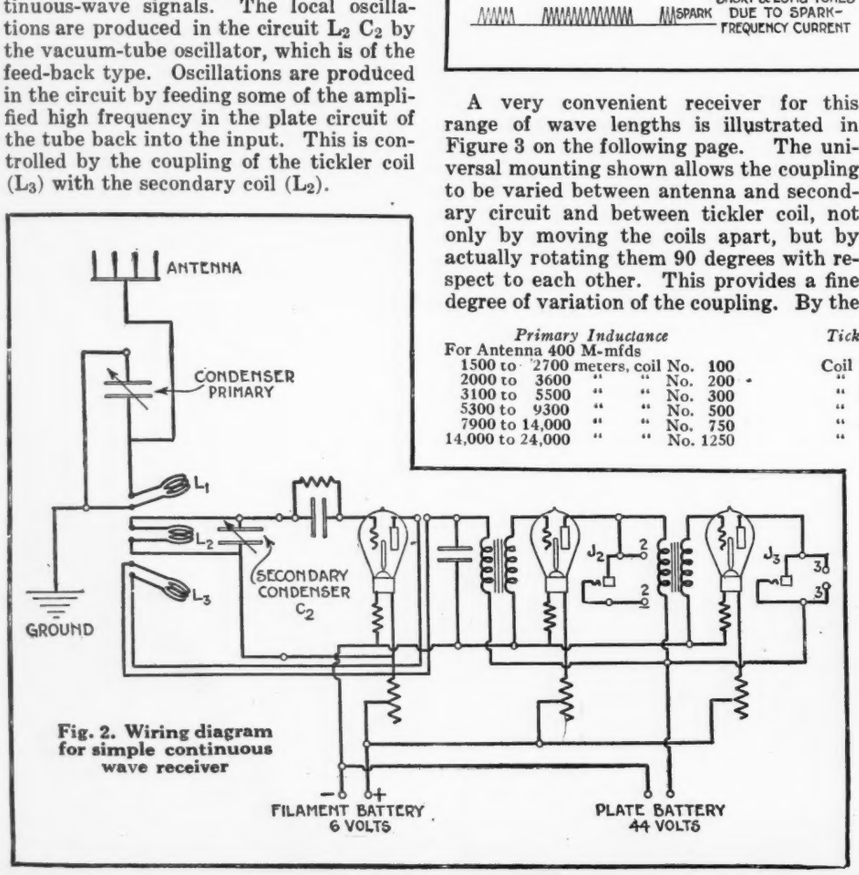
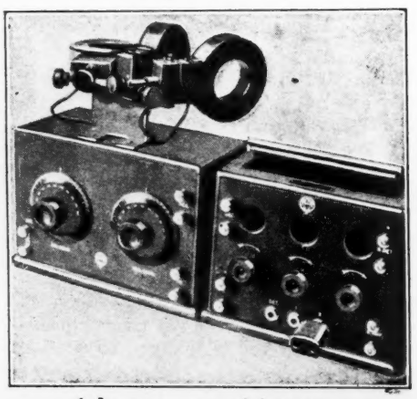
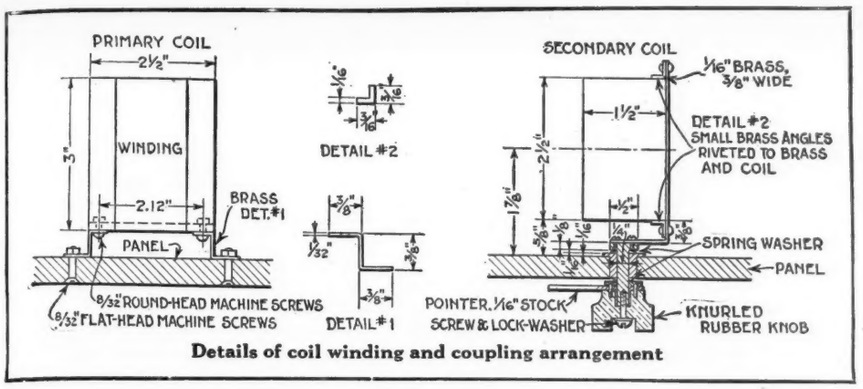


Fig. 2. Wiring diagram for simple continuous wave receiver



A long-wave receiving set



Details of coil winding and coupling arrangement

This receiver can be used with the detector amplifier described for the simple receiver by connecting the tickler coil to the proper binding-posts. In connecting the tickler coil, it should be remembered that it must be correctly poled. The photograph shows a convenient and neat detector amplifier and cabinet. With this receiver the high-power transatlantic and transpacific stations, the naval stations, and most of the post-office stations engaged in sending out market reports can be copied.

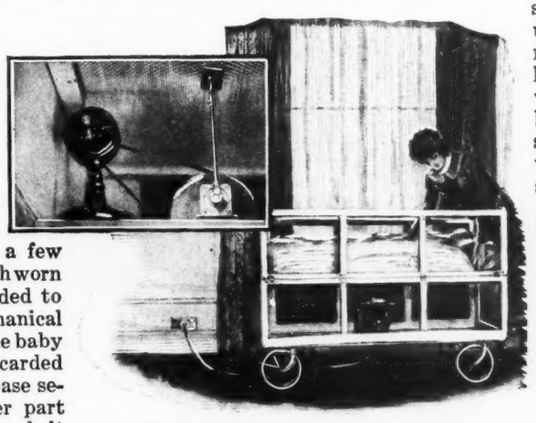
Using Electricity to Put the Baby to Sleep

By R. A. Squires

(Second Prize in "New Uses for Electricity" Contest)

WHEN our baby arrived, he started life with a severe case of colic, which kept us up at all hours endeavoring to quiet him. We shortly discovered that gently shaking him up and down in his crib would induce him to be perfectly quiet—as long as we kept it up.

This became mighty tiresome, even when my wife and I took turns, and after a few nights we were both worn out. So I proceeded to contrive a mechanical means to shake the baby by mounting a discarded fan motor on a base secured in the lower part of the crib. I ran a belt from the small pulley on the motor to a 6-in. pulley mounted on a short piece of shaft, which was provided with two bearings and a base for attaching.



The crib springs are gently joggled

On the other end of shaft I mounted a collar and drilled it for a crankpin about ⅜ in. off center. I then made a short connecting rod, one end with a bearing to snugly fit the crankpin, the other end attached to the center of the springs in the crib. The connecting-rod was later provided with an adjustment to compensate for the baby's weight as he grew older.

This device moves springs, mattress, baby, and all up and down about ¾ in. in a smooth and regular manner. A means of regulating the speed was provided by the use of a small self-contained rheostat sold for dimming a lamp. The motor as usually operated consumes about 20 watts an hour.

Does it work? Well, the baby is now over a year old. He has never missed a day going to sleep with the aid of the shaker, and we have never had to stay up at night to rock him or shake his crib since we put the electric shaker to work.

The outfit is self-contained with the crib and can be placed in any room. It has a cord connection for attaching to any convenient socket.

I might add that the crib is also equipped with electric milk-warmer and night-lamp.

Automatic Electric Doorbell Chimes

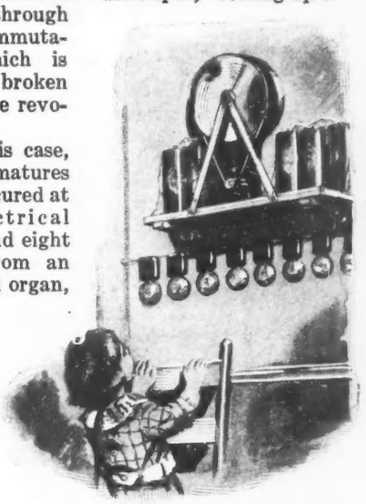
By J. W. Fritsch

(Third Prize in "New Uses for Electricity" Contest)

THIS device, requiring merely a momentary push of the front-door pushbutton, was designed to play the "Long Meter Doxology." The playing of more difficult selections is possible by the careful placing of the contact points.

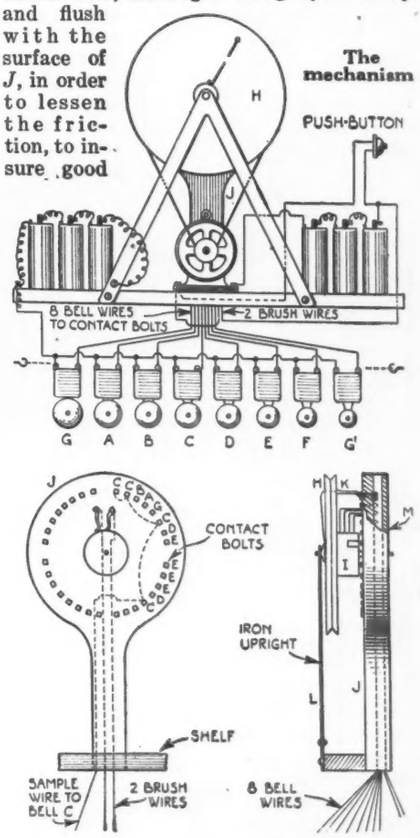
Three cells operate a toy motor, which drives the grooved wheel *H*. To *H* is attached a wooden commutator *I*, surfaced with sheet copper, in which there is a break of about ¼ in. to act as a circuit-breaker by disengaging one of the brushes at the completion of one revolution of *H*. One binding-post of the motor is connected with the pushbutton and with one of the brushes mounted in the upright *U*. The other brush is connected with the battery and from this same cell-pole another wire runs to the pushbutton. The other end of the battery, which is in series, is connected with the other binding-post of the motor. Upon a touch of the button, the motor drives the wheel *H* far enough to get the one brush off the "dead spot," setting up a circuit through the commutator, which is again broken after one revolution.

In this case, old armatures were secured at an electrical shop, and eight bells from an old reed organ,



The chimes

producing the octave from *G* to *G*¹, were mounted thereon. One wire connects all bells with another three-cell battery. From each bell a separate wire leads to one or several cam-headed bolts inserted through *J*, which is made of wood. The music begins on note C, therefore the C-bell wire connects screws 1, 2, 6, 13, etc., or all the C notes. The heads of the bolts are beveled on one side, making one edge quite sharp and flush with the surface of *J*, in order to lessen the friction, to insure good brush contact, and to make certain the sharp breaking of the circuit after each note. The brush *K*, made of copper, is attached to *H* by a bolt from which runs a wire to the metal collar on the axle connecting with the other pole of the battery through the cast-iron upright *L*.

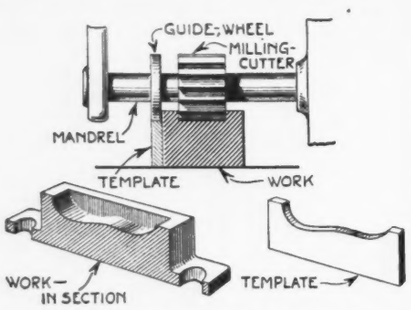


The mechanism

Since the stanza has four lines, a suitable pause is produced at the end of each by spacing each set of eight bolts somewhat apart. One end of the axle is carried by *M*, which is made of wood and is somewhat thinner than *J*.

Simplifying a Difficult Milling Machine Job

IN milling out an irregular depression in a piece of metal, much time is lost in lowering the table to measure the depth of the cut and then resetting the work to the tool. A template is required to gage the curvature of the inside surface, and when a template is made, it is quite as simple to make it correspond with the cut to be made. The job is then an easy one, as a small wheel is set on the mandrel outside of the

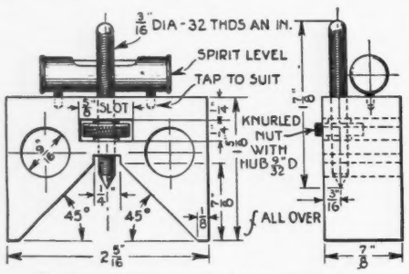


Template prevents cutting too deep

work and the template clamped against the work. The operator of the machine follows the profile, making it impossible to cut inaccurately, provided the template is clamped correctly.—L. A. G.

Machinist's Try-Gage for Cylindrical Surfaces

THIS try-gage has proved very useful in setting up cylindrical work on drill-press, planer, shaper, and slotter, and is



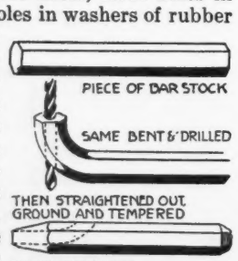
This machinist's tool is a time-saver

used by two men in the shop with which I am connected.

The tool should be made of steel carefully finished all over, with a level about 1½ in. long attached to the top.—WALTER WELLS.

Non-Clogging Hollow Punch

HOLLOW punches, such as are used for cutting belt-lace holes, rivet holes in fabric, or center holes in washers of rubber or leather, are difficult to make because the center hole must curve outward to the side of the punch to permit the passage of the cut out disks. There is, however, a simple way to make this type of punch.



A "curved" hole

Take a length of hexagonal or circular bar stock, heat and bend it, and then drill it as shown. Next straighten the bar, grind the end, and temper it. This method will provide a curved orifice that will not clog.—A. L.

Bench Talks

by ARTHUR WAKELING

TOOLS, like fine weapons, are very wonderful things when you come to know them well. They have made history. Every time we pick up a saw or an automatic drill or our "mikes," we are taking advantage of tool-building discoveries and achievements that run all the way back to the Age of Bronze.

There is no excuse for the man in the home workshop not having his tools always in good condition. And yet how many times have you seen a handy man laboriously hacking a shelf or what not out of a board with a dull and rusty saw! No wonder he has not the satisfaction in his work always felt by those who have the true craftsman's attitude toward tools—pride in their good condition.

Look for a moment at the sketch at the head of this article—a plane redrawn from Ernest A. Batchelder's book, "Design in Theory and Practice." It was made in medieval times, when many of the tools we use so casually to-day would have been regarded as little short of miraculous, but it leaves no doubt as to the craftsmanship of the man who made and used it. Would you have any hesitation in saying that he knew how to use tools and how to care for them?

The few pointers I should like to suggest to the home worker—whether he inclines toward woodwork or metalwork, whether he has an elaborate shop or wishes to do merely a few odd useful jobs around the house—are these:

Buy only the best tools—expensive at first, but an economy in the end.

Be sure to get the tools you really need. Only the expert mechanic can do good work with makeshifts and he usually won't try, for often the time and material wasted on a single job is worth more than the cost of the proper tool.

If, however, you have only a limited amount to spend on tools, choose a few good tools rather than a number of cheaper ones.

Learn to use your tools with the utmost precision and skill so that your work will always be finely done. The best way is always the easiest, the simplest, and the quickest in the long run.

To maintain edge tools in proper condition, notice the cutting angles that have been given to them by the manufacturers and preserve the same angles through the life of the tool as nearly as possible. Tool angles may range all the way from those of a penknife to a heavy lathe tool. It is always a matter of selecting an edge that will be sharp and reduce friction and at the same time strong and permanent enough to stand up under the work to be done. You may be sure the toolmaker has worked the angles out very carefully, so that all you have to do is to use your grindstone and oilstone constantly to keep those angles right. Having edge tools well sharpened and well lubricated is half the battle.

Tools of the hammer, punch, trowel, and wrench class will not trouble you much, but the tools you use for making and testing measurements deserve your greatest consideration. Even a steel square or try-square can quickly be spoiled by a little carelessness; and rules, gages, calipers, surface plates, protractors, levels, and the like, require the best of treatment if they are to retain their accuracy. Protect these tools in every way from being strained, warped, nicked, or damaged.

These hints, if adhered to, will, I am confident, help make your home workshop at once more pleasurable and more profitable.

A Bookcase that Folds into Small Space

By Robert H. Raymond

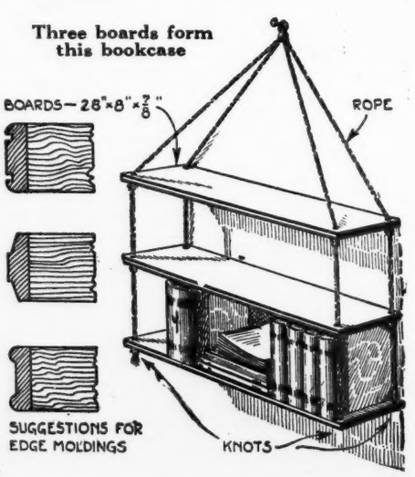
FOR students who live in crowded quarters or who travel much, this bookcase will prove of value, for it can readily be put up and taken down and occupies little space in a trunk or box.

Make three shelves ⅞ in. by 8 in. by 2 ft. 4 in. of any common wood. Bore a ¼-in. hole at each corner ½ in. from the edges. All the shelves may be held together with a hand screw and bored at the same time.

The appearance of the shelves depends on hard-wood strips of mahogany, oak, walnut, or other cabinet woods mitered around the front edge and the ends. They should be the same width as the thickness of the shelves and ¼ in. or ⅜ in. thick. Fasten them with brads. Then stain the shelves oak, mahogany, or whatever stain will harmonize with the wood you selected for the edges.

Four pieces of 3/16-in. manila rope or strong cord, colored if preferred, about 1¼ yd. long, are knotted and passed through the shelves, leaving about 10 in. and 9 in. respectively for the lower and upper book compartments. The knots must be spaced exactly alike on each piece to insure a workmanlike job. At any time an additional straight length may be carried up to the ceiling, or to the picture molding if it is well nailed.

Three boards form this bookcase



$9.75 No. 437

Protect your home and earnings

It is of **vital importance** that when you need a firearm it must be **absolutely dependable.** Everyone of our automatics is made of finest materials by expert workmen, and then fully tested before leaving factory. That is why we can sell them with an absolute guarantee of money back if not satisfied after examination. We are undoubtedly the largest direct-by-mail distributors of revolvers—selling thousands direct-to-the-consumer. That is why we can offer you a genuine bargain dependable automatic for the heretofore unheard of rock bottom price of $9.75. Every one owes it to their family and to themselves to keep one of these new safety automatics always at hand, to fully protect against burglars, thieves and hold-up men.

Frightened---A Noise Downstairs

It is a terrible fright to wake up in the night—hear noises downstairs and realize that your neglect has left you wholly unprotected. One of these famous Paramount Revolvers will fully protect you.

25 Cal. Automatic

No. 152 is 25 Cal. automatic as illustrated. 7 shot. Has double safety and is practically fool-proof against accidents. Handsome blue steel gun metal finish. Checkered grips. Accurate aim. Rifled barrel. Lies flat and will not bulge out pocket. Big Bargain
Our special price $9.75

No. 3652. Same style as above only .32 cal., 7 shots. Big Value.
Our price only..... $11

No. 552
32 Cal.
Military Model.. $12

10 Shot, extra magazine free making 19 shots.

Famous 32-20 Texas Ranger

7 Shot Hand Ejector $14.50

The fact that this gun shoots 7 times without reloading makes it very desirable. This is the only hand ejector side swing that has a safety feature which will prevent accidental discharge. Has swivelled handle and is made for rough use. Of excellent material. The barrel is 4 inches long, rifled and shoots the famous 32-20 cal. cartridges which gives it great penetrating power. We are selling this gun at a remarkably low price and the Paramount Trading Co. guarantees that you will be entirely satisfied with this wonderful bargain.
No. 5500..... $14.50 and postage.

Hand Ejector $17.50

Popular Swing-Out

cylinder revolver made by expert mechanics and extra fine steel. Model adopted by police and secret service in many cities. Nickel or blue finish. Pearl handles $3.00 extra. When ordering state, whether nickel or blue finish is desired.

No. 1073, 32 Cal.....$17.50 and postage
No. 1573, 38 Cal.....$19.00 and postage

Double Action Automatic Ejector $7.75

This handsome firearm is accurate and dependable. Only dependable weapon at a low price made. Has popular break cylinder made of extra fine nickel steel. Shoots 5 times before re-loading.

No. 2022 is 32 Cal. 3¼ inch barrel. Pay postman $7.75 and postage on arrival.
No. 2522 is 38 Cal. 3¼ inch barrel. Pay postman $9.00 and postage on arrival.

No. 3010 is 44 Cal. 6 shots. Nickel only. $14.50 and postage.

Cartridges for the break and swing can be bought anywhere, or can be furnished for any of the above by express only. For 32 Cal., $3.50 per 100; for 38 Cal., $4.50 per 100.

Genuine German
LUGER

No. **4152.** 30 Cal. We guarantee this to be the latest design of the famous Luger automatic, also that it is a genuine Luger and not a Luger Model. It shoots 9 shots. Has automatic magazine ejector, safety devices, which makes accidental discharge impossible. Shoots 30 cal. ammunition, which we will furnish or you can secure from your local dealer. Exceptional value. $28.50
Our Special Price.....

Automatic Cartridges for this gun $5.00 per 100 by express only

Cartridges

All 25 and 32 Cal. Automatics shoot all standard makes of Automatic Cartridges, obtainable from your dealer or from us by express only. 25 Cal. $3.75 per 100; 32 Cal. $4.50 per 100.

MONEY-BACK GUARANTEE

The Paramount Trading Co. guarantees that these are all brand new guns and not reclaimed. We further guarantee that you will be entirely satisfied with your purchase and if for any reason you are not satisfied return it to us immediately and we will refund your money. We also guarantee that your revolver will be delivered in perfect condition to your door. You take absolutely no risk in ordering any of these guns as our guarantee protects you in every way. Rush your order to-day. Be sure to mention the number of the gun you wish.

SEND NO MONEY

Select the particular revolver that suits your particular needs to-day. Write clearly your name, address and number of the revolver you desire (a post card will do).

The postman will deliver your revolver to your door, for we ship by return mail. Pay postman on arrival, our price plus the few cents postage. Send for FREE Catalog.

HOLSTERS

Handsome genuine leather holsters. These holsters have been manufactured according to our specifications and are of the best material, durable and we guarantee them to give satisfactory wear.

25 Cal. holster.....$1.00
All other holsters.....$1.50

PARAMOUNT TRADING COMPANY
34 West 28th St.
New York, N. Y.

Our Blueprint Will Help You Make This Smoking Cabinet

A SMOKING cabinet with self-contained ashtray in each end forms the subject of the second blueprint in the series prepared by the Home Workshop Service Department.

Every man who works with tools, whether he is a novice or a mechanic of long experience, will find this problem interesting, not alone because of the unusual attractiveness of the design, but also because he can make the cabinet in a number of different ways, ranging from easy to difficult.

The humidor part of the cabinet is a box 8 by 10 by 16 in., with joints that are very nearly airtight. When the lid is lifted, two pins may be pulled up to release small doors, one in each end. These doors dropping to form an angle of about 45 degrees with the ends, support two hopper-shaped removable ashtrays. The trays and other metal fittings can be constructed easily by the home worker from sheet copper or brass. The whole arrangement, besides being novel in design and a neat piece of craftwork, has the advantage that when the ashtrays are not in use, they are closed up within the box.

The interior of the box, intended for cigars and cigarettes, can be divided into compartments if desired. The design provides for two small troughs for match-boxes, cigar and cigarette holders, and pipe-cleaners.

To order a blueprint, fill out and mail the coupon at the bottom of this page.

The cabinet may be made plain, carved, inlaid, or enameled black and decorated with oil colors

Four methods of finishing the stand are suggested. It can be enameled black and painted with a colorful design, somewhat reminiscent of peasant art. This is both effective and easy, because any imperfections in the workmanship can be concealed and the joints could even be fastened with brads. The second method calls for a natural finish, in which case only fine woods should be used, preferably mahogany, walnut, or quartered oak. The third method involves simple wood-carving, done with a carving tool or small gouge. Although this is a most artistic and craftsmanlike way of ornamenting the box, it requires no special skill in wood-carving, since the lines are all straight gouge marks laid out in an interesting pattern. The fourth method suggested is to inlay the box with bandings, which is intended only for experienced workers.

If it is not desired to make the stand, the box alone will be a project well worthy of your best efforts.

A blueprint, 15 by 22 in., containing complete working drawings and bill of materials, will be sent to any reader of the Home Workshop for twenty-five cents. If you wish one, please fill out the coupon at the bottom of this page.

Coldframe and Sash Simplified for the Home Worker

A cheap and easily made coldframe

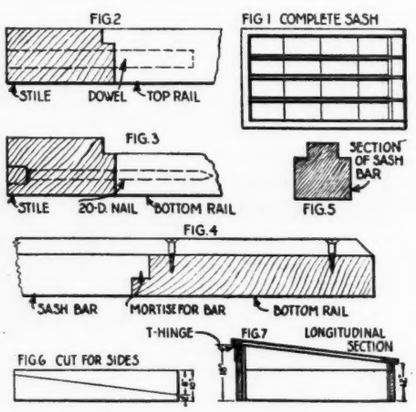
BY the following simple method a strong coldframe sash may be made cheaply in the home workshop. The same tools will be needed as for the storm sash described last month on page 120.

Any size desired may be made; the example given is 2 ft. 8 in. by 4 ft. 6 in. for the sash and 2 ft. 6 in. by 4 ft. 4 in. for the outside measurements of the frame. The stiles (side pieces) and top rail, like those in the storm sash, are 1⅛ in. by 2¼ in. rabbeted on one edge only, ¼ by 5/16 in., as seen in Fig. 2. The bottom rail is ⅞-in. stuff, which is actually 11/6 in. less as ordinarily manufactured today, and it is 5 in. wide. Cut it off square at both ends, 2 ft. 3½ in. long. The top rail will be ½ in. longer, or 2 ft. 4 in. in length. Cut it at each end as shown in Fig. 2.

The stiles are 4 ft. 6 in. The 3 bars are 1⅛ by 1⅛ in. rabbeted on both edges, as shown in Fig. 5. They should be 4 ft. 4 in. long. The cut for the bars at the top is similar to that in Fig. 2 and they should be securely nailed with 1¼-in. brads. At the bottom the cut is as shown in Fig. 4, small mortises being made in the bottom rail. The bars are fastened to the face of the bottom rail with small screws, as shown in Fig. 4.

The sash may be nailed together with tenpenny nails set well in, and then bored for dowels, as shown in Fig. 2, or fastened with twentypenny nails, for which holes should be bored a trifle smaller than the diameter of the nails, as shown in Fig. 3.

Instead of glue, white lead should be applied to all joints before nailing. Precaution should be taken to see that the sash is braced square before putting in the dowels of the twentypenny nails. T-hinges may be used, if desired, as shown in Fig. 7, and, to give additional strength to the sash, 6 in. flat corner plates may be placed on each corner on the lower side.



Complete details of sash and frame

The coldframe, as designed, is of 10-in. plank. If this is 2 in. thick, the required material is 3 pieces 4 ft. 4 in. long and 3 pieces 2 ft. 2 in. long. If it is 1½ in. thick, the last 3 pieces should be 2 ft. 3 in. long.

Cut one of the short lengths in two pieces, giving a slight bevel to the saw and making one piece 2 in. wide, and the other 8 in. wide. Cut one of the long pieces as shown in Fig. 6.

The frame is now ready to be spiked together with heavy pieces nailed down the inside corners that will serve to render it more durable and workmanlike.—A. E.

Please Use This Coupon for Ordering Blueprints from the Home Workshop Service Department

The Home Workshop Service Department,
Popular Science Monthly,
225 West 39th St., New York.

GENTLEMEN:

Send me the blueprint or blueprints I have checked below. I enclose 25 cents for each one.

No. 1 Sewing- or Work-Table **No. 2 Smoking Cabinet**

Name..... Street.....

City and State.....

The Radio Magnavox, Type R-2, with 18" horn. The original loud speaker, and now the world's standard. The most attractive and most efficient piece of apparatus of its kind manufactured. Beautiful black enamel finish, nickel plated trimmings, and solid mahogany base with piano finish. Indispensable to those who take pride in their set and the results achieved.

The Radio Magnavox, Type R-3, with 14" horn. Beautiful and durable as it is efficient. Reproduces wireless music and messages in volume without distortion. Anyone can operate it, every one can enjoy it. No adjustments or extras required. No radio set complete without one. *There is no substitute for the Radio Magnavox.*

Wireless music for home entertainments

ENTERTAIN your friends with radio concerts, enjoy the fascination of radio as a hobby, make wireless a profitable part of your business, get news and market reports before they are published, take public speeches off the air. With a simple receiving set and a Radio MAGNAVOX you can do all this, and more, too, in your own home or office. The front cover of this magazine shows how easy it is, with a Radio MAGNAVOX.

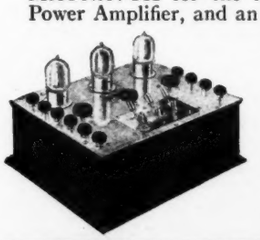
Practically every variety of vocal and instrumental music from jazz to grand opera, news reports in plain English, and many other special features are radio broadcasted daily, *free* to anyone with the simple equipment to receive and reproduce them. Read the article in this issue.

The Radio MAGNAVOX will reproduce them for many people at the same time. Without the MAGNAVOX only the operator wearing a head set can hear. Simply substitute the MAGNAVOX for the head set, hook up with a Magnavox Power Amplifier, and an audience of one or one thousand may hear perfectly. This MAGNAVOX equipment enables everything received by radio to be swelled in volume to the full sound intensity required for any occasion, without losing even the most delicate tone modulations or a single bit of the original clearness and distinctness. It makes a radio set adaptable for office, store or factory use, and the use of radio music practical for home entertainment, concerts and dances. It adds to any set the final touch of up-to-the-minute completeness and multiplies its scope and usefulness many times over.

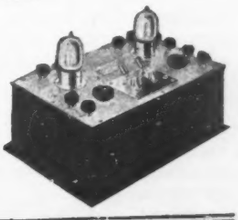
You yourself can operate the MAGNAVOX the very first day without any previous training or experience. The hook-up is easy, and there are no adjustments. The few instructions necessary furnished free with each outfit. The entire cost no more than the price of a good phonograph.

Any first class radio dealer will install it for you, and give you any further assistance required.

The Magnavox Company are world pioneers in the development of sound amplifying apparatus. It was MAGNAVOX apparatus used by the U. S. Navy and the U. S. Signal Corps to perfect their communication during the Great War. It is MAGNAVOX apparatus now being used by the majority of prominent speakers for addressing large audiences. The facilities and experience which developed this apparatus are back of each piece of equipment bearing the MAGNAVOX trade mark, and are available to you now in making radio simpler, more useful and more enjoyable. Write us a letter or mail the coupon below to our nearest office for FREE *Magnavox* folder.



RADIO MAGNAVOX



Magnavox 3-Stage Power Amplifier. Same as 2-Stage, type, except larger and more powerful. Designed to energize MAGNAVOX where particularly large volume is required for hospitals, public buildings, outdoor entertainment, etc. The final touch of completeness to any set. Solid mahogany finish.

This trade mark on all MAGNAVOX apparatus, Look for it, Accept no substitute.

THE MAGNAVOX CO.—General Office—OAKLAND—CALIF.
NEW YORK OFFICE—370—7th Ave.—Penn. Terminal Bldg.
Please mail this coupon to Magnavox office nearest you.

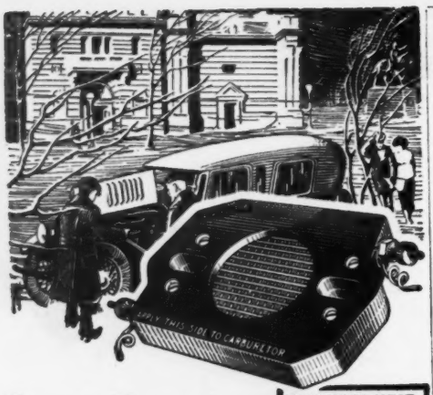
Please mail me, without cost or obligation, your very interesting folder illustrating and describing the Radio *Magnavox* and the *Magnavox* Power Amplifier, also name of nearest radio dealer who can supply me with same.

NAME_____

ADDRESS_____

If you wish list of other Magnavox Sound Amplifying devices, and information concerning same, place a check mark here ☐

Magnavox 2-Stage Power Amplifier. Designed to furnish power for the Radio MAGNAVOX, and minimize the possibility of sound distortion where maximum results are necessary. All binding posts plainly lettered. Simply throw the switches to operate. Solid mahogany case.



"ELECTRIC HEAT DOES IT"

Starts Your Car Instantly in Coldest Weather

When You Step on Your Starter — made for all cars and trucks

EVERYONE knows how difficult it is to start the motor in cold weather. That is because gasoline vaporizes very slowly when cold. Long continued use of the starter to overcome this condition leads to damaged battery, undue wear and tear on starter, a waste of gasoline and crank case oil dilution.

The **Aske Electric Vaporizer,** by breaking the gasoline globules into finer particles and electrically heating before entering cylinders of motor changes a cold, wet, sluggish mixture into a dry, active gas that gives instant starting of motor.

Any motor will start instantly in the coldest weather, when equipped with our vaporizer.

Reference to illustrations shows the simplicity of the **Aske Electric Vaporizer,** and easy manner of installing. It fits like a gasket between carburetor and intake manifold. Pushing switch button on dash for a few seconds heats the copper grids with current from lighting battery. When motor is started, gasoline is drawn through these four grids and atomized and preheated in passing. As soon as motor starts, taking finger from switch automatically shuts off current.

The **Aske Electric Vaporizer,** in addition to being an almost indispensable convenience, saves battery, starter and time; while the reatomizing of gasoline also produces a gas saving of 20% to 25%.

If your dealer is unable to supply you, write to nearest distributor, or the manufacturer, at once. You need the Aske **this** winter. Money-back guarantee.

Dealers: The Aske Electric Vaporizer meets a real demand that has been awaiting this solution of cold weather starting difficulties. Write to nearest distributor today for literature and particulars of our liberal proposition. **Now** is the big season —don't delay.

Price $7.50 complete with automatic switch and everything necessary to install. Easily and quickly installed in an hour or less without alteration to motor.

Manufactured by

KASE ELECTRIC COMPANY

10-15 Sherwood Bldg. Duluth, Minn.

DISTRIBUTORS:

Horgan-MacDonell Co., 939 Washington Blvd., Chicago, Ill.
Tri State Sales Co., Palladio Bldg., Dept. 1, Duluth, Minn.
Kase Electric Co. of New York
136 Liberty St., New York City

T. Eaton Co., Winnipeg, Canada.

You Have a Chance to Win a Liberal Bonus by Sending Your "Best Ideas" to the Home Workshop

WHAT is your "best idea" for the Home Workshop? A first prize of $15 and a second prize of $10 will be awarded in April, May, and June for the most interesting, useful, and attractive articles contributed to the Home Workshop.

These monthly prizes will be a bonus given for especially good suggestions of the kind used in this department. In other words, each idea that is available for publication in the Home Workshop will be purchased at the usual rates, and the prizes will be in the form of extra checks sent out when each month's competition is decided.

It is, of course, preferable that the articles be as short as possible, consistent with all necessary accuracy and clearness, and illustrated with sketches or photographs. The sketches need not be finished drawings, but they should convey adequately the writer's idea.

There is probably not a single reader of POPULAR SCIENCE MONTHLY who has not in his experience run across just the sort of idea that might win a prize. Send your contributions in as promptly as possible, addressing them to the Home Workshop Editor, Popular Science Monthly, 225 West 39th St., New York.

The March prize-winners in the old "Best Idea" Contest, which is concluded this month, are as follows:

FIRST PRIZE, $35: *R. A. Houston,* S. Charleston, Ohio (see page 89).

SECOND PRIZE, $15: *W. D. Kendrick,* Miami, Ariz. (see page 85).

Design for Phonograph Record Rack

By Roland B. Cutler

HOW often have we looked through a stack of paper-cased phonograph records and left them "kicking" about the room for some one else to put away?

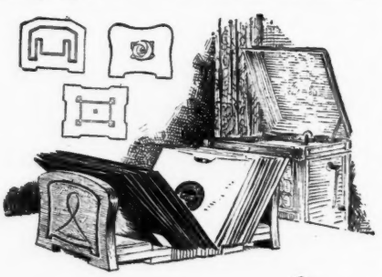
This wouldn't happen if the records were kept in a rack like the one illustrated, where they are instantly available and can be turned like the leaves of an open book. It takes no more time to replace them than to lay them on the table, and any and every make or size of flat record can be accommodated.

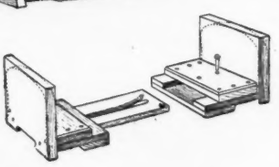
The rack will be such an attractive addition to any table that it is advisable to make it of quartered oak or mahogany, if there are not some pieces of broken furniture around the house that can be utilized. Besides screws or brads, you will require a 6-in. coil-spring ½ in. in diameter, and two sixpenny nails.

The end pieces are ⅞ by 8 by 9 in. and may be shaped and ornamented in any way desired. Simple line carving will be effective and appropriate, or the design can be stained or inlaid with bandings or marquetry, or the ends can be left plain—whatever the surroundings demand.

The other material required will be two pieces ⅞ by 4½ by 8 in., four pieces ⅞ by 2 by 6 in., two pieces ½ by 3 by 8 in., and one piece of soft wood ⅞ by 4 by 12 in. On the center line of the latter, ½ in. from each end, bore ¾-in. holes and cut out a ¾-in. slot between them. Then assemble the ends and slide them on to the long piece. Connect the coil-spring by placing it in the slot and attaching each end to a nail inserted through holes drilled as indicated. The ends will then be drawn together by the action of the spring.

To the bottom of each paper envelope attach two cardboard tabs. These should extend about 1½ in. below the bottom edge and be a trifle more than 4 in. apart. They can be attached most conveniently with sealing-tape, 7 in. of which will be sufficient





Details of the rack

to go around the piece of cardboard and stick to each side of the envelope, as shown. This will take but a moment for each record.

To adjust the tension of the spring for the number of records it is desired to keep in the rack, shift the nails from one hole to another in the upper cross block. The space at the ends can be used for record catalogs, if desired.

The Home Workshop Calendar of Timely Hints for March

MAKE a coldframe and sash for an early start in the garden (see page 82).

Overhaul the gardening equipment. Provide yourself with a wheel-hoe if you do not have one (see page 106).

The home workshop can also assist the gardening plans by making plant labels and a straight-edge and measuring stick for the flower beds, and by preparing bean poles.

The repair of grape arbors, garden shelters, sheds, etc., after the winter storms will also call for the home worker's mechanical skill.

Do not permit the high winds of March to find a rattling window or poorly fitting door (see page 108 of this month's and page 100 of the February POPULAR SCIENCE MONTHLY).

As the milder weather approaches, the gas-stove will more and more replace the coal-range for cooking. This is, therefore, a good time to make the gas-saving device shown on page 106.

The poultry yard will soon be a busy place. Eliminate waste by making self-feeding hoppers (see page 89), and, if the hens are backward in laying, try the water warmer described on page 102.

See that your auto gets a good overhauling for early spring use. If you are buying a new car this season, line the hood with asbestos, as described on page 89.

The spring rains will make a poorly built cellar quite damp, but there are remedies, and they should be applied as promptly as possible. Two of them are described on page 86.

This is a good time to make roof repairs, if any are needed.

Get a start on the spring housecleaning, if possible, and have some of the outside painting done.

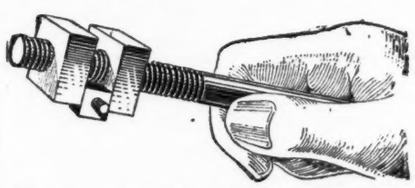
Make a frame for the icebox pan to prevent the floor becoming damp (page 86).

Making a Wrench from a Bolt and Two Nuts

By W. D. Kendrick

(Awarded Second Prize in "Best Idea" Contest for March)

FROM my experience in using all kinds of tools I have found most valuable a simple idea for making adjustable wrenches to suit the work in hand. These are made



This wrench may be improvised instantly

simply of a bolt and two nuts with the square faces of the nuts turned inside.

Any size bolts and nuts can be used and the bolts may be long or short, whichever is more convenient. A long bolt might be desirable for reaching into a place where an ordinary wrench won't go, and a very short bolt will be found particularly useful in tight corners where there is little room for a wrench handle. This combination of a bolt and two nuts can also often be used as a hand vise.

Be More Careful

of your teeth—combat the film

If you are brushing your teeth in a wrong way, learn what this new way means.

Authorities now advise it. Leading dentists everywhere are urging its daily use. Millions of people employ it.

Make this ten-day test and let the results show you what really clean teeth mean.

That dingy film

Film is what clouds the teeth's beauty. It causes most tooth troubles. Countless teeth discolor and decay because the old ways of brushing do not effectively fight film.

Film is that viscous coat you feel. It clings to teeth, enters crevices and stays. That is what discolors—not the teeth.

Film is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Germs breed by millions in it. They, with tartar, are the chief cause of pyorrhea.

Ways to end it

Dental science has in late years found two ways to fight film. It has proved them by careful tests. Now they are embodied in a new-day tooth-paste—called Pepsodent—for daily application.

Dentists here and abroad now advise it. It is now bringing a new dental era to some 40 races of people.

Other new effects

Pepsodent brings three other effects, natural and very important.

It multiplies the salivary flow.—Nature's great tooth-protecting agent. It multiplies the starch digestant in the saliva, to digest starch deposits. They may otherwise cling and form acids.

It multiplies the alkalinity of the saliva, to neutralize the acids which cause tooth decay.

Thus every use does five things which dental authorities now regard as essential.

You'll quickly see

A 10-Day tube of Pepsodent is sent to all who ask. That shows the delightful effects. In a week you will realize that this method means much to you and yours.

Send the coupon for it. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear.

Watch all the effects, then read the reasons in our book. That test may lead to life-long benefits. Cut out the coupon now.

Pepsodent PAT. OFF. REG. U.S.

The New-Day Dentifrice

A scientific film combatant, whose every application brings five desired effects. Approved by highest authorities, and now advised by leading dentists everywhere. All druggists supply the large tubes.

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Keeping the Home Shipshape

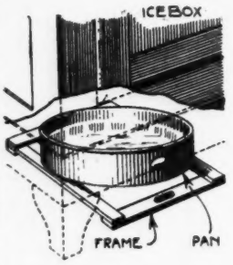
How to do those odd jobs that save time, temper, and money

Frame for Icebox Pan

THE floor under an icebox seems always to be moist or wet because the condensation of moisture on the outside of the ice-cold pan trickles down and never has a chance to dry.

This can be prevented by making a frame like that illustrated from four strips of wood and two small blocks. It will raise the pan sufficiently to provide ventilation all around and the dampness will disappear.

A hand-hold cut in the front rail of the frame will make it easy to slide out frame and pan.—A. E. Z.



Prevents dampness

Hints on Hardware

WHENEVER it is necessary to put on hardware of any kind, the homeworker can make the task easier by observing a few kinks of the experienced carpenter.

Always read the printed directions, if any have been furnished with the lock, spring, or whatever you happen to be fitting. Take the time to do exceedingly accurate work. Don't use a pencil for marking, but a sharp penknife or a scriber. The thickness of a pencil line is enough to spoil the neatness of such a job as putting in a chest lock.

Be sure that such things as drawer-pulls and escutcheons are level and plumb. Give a professional touch to your work by alining the slots in the screws, either horizontal or vertical. The difference it makes in the appearance of such fittings as hinges, locks, escutcheons, finger-plates, and the like, is surprising. Patented locks, sliding-door hardware, and door-checks are difficult for the home worker to install, but care and patience will go a long way toward insuring success.—A. W.

For Fire-Fighting

AN EXTINGUISHER of some sort should be kept in the hall near the stairs on all the upper floors of the house. In case of a blaze, the stairs are the danger spot; they are the strategic line of communication which must be defended and kept open at all costs.

Water is the cheapest fire-extinguisher obtainable and also one of the most effective. It should be stored in the regulation 10-quart pails, painted red to distinguish them and prevent their being used for other purposes. They should be regularly refilled once a week.

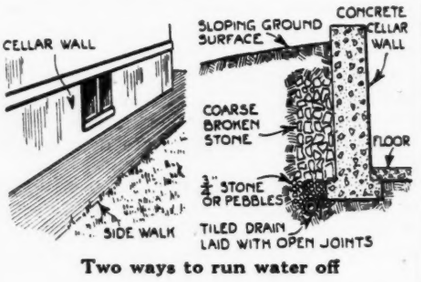
The pails are so unsightly that the home worker should place special shelves for them in the hall closet, which is usually near the stairs, or, better still, he can construct a long, narrow closet high up on the wall near the head of the stairs. It should be large enough for at least three pails.

The way to use water in fighting a fire is not to dash the whole pail at once in the general direction of the flames. It is better to dip a broom in the bucket and spatter the flames with water. For this reason always keep a broom near the fire-pails.—C. H. D.

Keeping Cellars Dry

DAMP cellars are always a source of annoyance, but they are not always easy to remedy, especially in clay soils.

Sometimes the difficulty is due to the fact that a cement walk runs along the foundation at a distance of perhaps 6 or 8 in. from the wall, so that rainwater seeps through the earth between the walk and the wall and enters the cellar. It is advisable always to build a walk right up against the wall and slope it well to drain water away. If for any reason this cannot be done, the ground between the walk and the wall should be well tamped, sloped away from the wall, and sodded.



Two ways to run water off

To drain off excessive ground water, a tile drain should be laid with open joints, as shown, along the base of each wall. If the concrete foundation wall is fairly good, the water will not enter it, but will drain through the layer of coarse broken stone and pebbles into the tile and flow away to lower ground or a cesspool.—M. H.

Renovating Wallpaper

INDIA rubber and an ink eraser will take off such spots from wallpaper as are apt to appear near tables. Bear lightly on the eraser or the pattern will be rubbed off.

Grease spots yield to a pad of blotting-paper held by a hot iron—not *too* hot an iron or the paper will be scorched. Repeated applications of benzine, allowing time for drying, will also remove grease spots on wallpaper. Cover a pad of cheesecloth with bran and rub the paper with this, replenishing the bran as it drops away.

Specially dirty spots, such as register the marks of children's fingers, should be gone over with fresh bread. Allow the bread to crumble away while rubbing, so that a clean surface will constantly be used against the paper.—R. E. K.

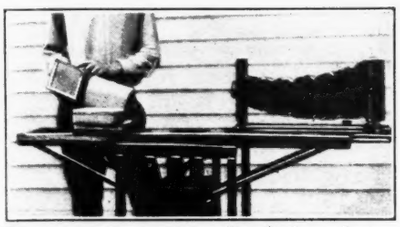
THE HOME WORKSHOP

Making Your Own Designs with a Camera

By E. Bade

THE home worker who is interested in crafts of a decorative nature will find himself constantly looking for good design motifs. They are often exceedingly difficult to find, as professional designers can testify.

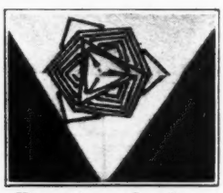
Perhaps a design is needed for an ornamental border to be stained or inlaid around a picture-frame, or it may be an over-all pattern for a hammered copper tray, or a floral decoration for a hand-tooled leather book-cover, handbag, or



The apparatus set up for design photos

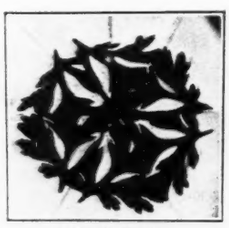
mirror back. How can you find an appropriate design?

You may very easily obtain original, striking, and excellent new ideas in design by using your camera, three mirrors, one plate of plain glass and one piece of ground glass. Fasten the three mirrors, which must be of equal size and without flaws, together with cord into an equilateral triangle, wrapping around them a large piece of cardboard to form a tight-fitting cylinder. The segments between the cylinder and the prism are filled with cotton.



The triangular form

The two glass plates should be larger than the triangle of the mirrors. Cut a strip of cardboard ¼ in. wide and just long enough to go around three sides, and glue it to the perimeter of the plates with paper to form a shallow glass box.



A leaf design

The camera is focused on the lower corner of the triangle of mirrors farthest from the camera. Care must be taken in tilting the cylinder so that a perfectly triangular image is thrown on the ground glass. The image will consist of six smaller triangles, the upper one being divided in half. If various articles are now placed in the glass box and held back of the mirrors, a design will be formed on the ground glass of the camera. Buttons give unique effects, small flowers provide floral designs, and leaves can be successfully used if they are feathered or deeply lobed. Matches give Chinese and Japanese suggestions, and paper clips make the most delicate scroll designs. Even a piece of string loosely doubled up will produce an amazing number of decorative arrangements.

FORTY-THREE years ago Alexander Graham Bell, the inventor of the telephone, wrote this inspired forecast: "It is conceivable that cables of telephone wires could be laid underground or suspended overhead, communicating by branch wires with private dwellings, country houses, shops, manufactories, etc., and a man in one part of the country may communicate by word of mouth with another in a distant place."
At the right, an old print of Bell lecturing on telephony, 1877.

Foresight

More than forty years ago, when the telephone was still in its experimental stage, with but a few wires strung around Boston, the men back of the undertaking foresaw a universal system of communication that would have its influence upon all phases of our social and commercial life.

They had a plan of organization capable of expansion to meet the growth they foresaw; and their wisdom is borne out by the fact that that plan which they established when telephones were numbered by dozens is efficient now when telephones are numbered by millions.

This foresight has advanced the scientific development of the art of telephony to meet the multiplied public requirements. It has provided for funds essential to the construction of plant; for the purchase of the best materials on the most advantageous terms; for the training of employees to insure skilled operators; for the extension of service in anticipation of growth, with the purpose that no need which can be foreseen and met will find the Bell System unprepared.

The foresight of the early pioneers has been developed into a science during the years which have elapsed, so that the planning of future operations has become a function of the Bell System. This is why the people of the United States have the most efficient and most economical telephone service in the world.

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These letters—which are fair specimens of hundreds we are receiving—show that the "Six Reasons" for preferring the Y. M. C. A. system of correspondence instruction are well founded.

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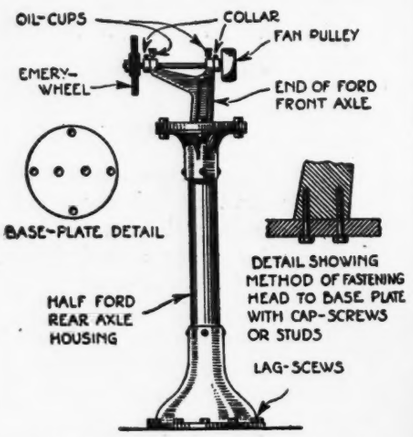
THE HOME WORKSHOP

Polishing-Head and Stand Made from Old Auto Parts

A SMALL polishing-head and stand can be constructed from discarded Ford parts at very little expense.

The stand is one half of the rear axle housing, lag screwed to the floor with the differential housing down. The top flange, against which the brake drums formerly revolved, should have four holes drilled about its circumference at equal distances. Cut out a heavy iron plate the same diameter as the flange and drill four holes to correspond and two larger ones in the center, as shown.

Next, saw off one of the spindle bearings from a front axle, so that when it is set upon



This rigid pedestal grinder costs little

the sawed end the two bearings will be exactly horizontal. Drill two holes in the sawed end to match those in the center of the plate and tap them for long cap screws or studs. Fasten the bearings to the plate and the plate to the flange. Welding the joint of the bearing to the plate will make an even stronger job.

A small shaft can easily be found for the polishing-wheel. Provide two collars with set-screws to hold it in the desired position.

Fit an old Ford fan pulley to the end of the shaft projecting from the vertical arm of the bearing-piece and thread the opposite end of the shaft to accommodate two disks and a nut by which the polishing-wheel can be secured in place. Drill and tap for two oil-cups, one over each bearing.

Small emery-wheels and buffers can be used on this outfit as well as a fan. It will do the work of a commercial machine without costing nearly as much.—L. B. R.

How to Solder Aluminum

TO solder aluminum, first make a soldering bit from a piece of $\frac{5}{8}$ or $\frac{3}{4}$ in. round or square aluminum. Next, tin the parts to be soldered with a composition of 81 per cent tin, 16 per cent aluminum, and 3 per cent copper.

After the copper has fused, the aluminum should be added little by little, stirring the mixture thoroughly all the time. The tin and a small portion of tallow should be added. Do not overheat the composition.

BOYS can find many uses for old inner tubes. They make excellent slingshot rubbers, toy airplane motors and the like. Much fun can be had in swimming with an old inner tube that will hold air.

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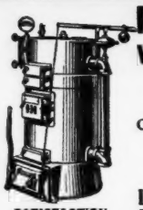

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THE HOME WORKSHOP

Line the Hood of Your New Auto with Asbestos

By R. A. Houston

(Awarded First Prize in "Best Idea" Contest for March)

IT doesn't take long for a new car to lose the fresh gloss on the hood. That is because the hood is subjected to great extremes of heat and cold. When the hood is hot and gets wet, the finish is apt to check and crack.

A simple preventive is an asbestos lining for the hood. The inside of the hood is thoroughly cleaned and shellacked and before the shellac is dry, sheets of asbestos paper, such as are used to cover pipes, are pasted to the under side. A coat of shellac is then given the paper to make it impervious to grease and oil. In putting the asbestos on, holes should be cut out to correspond with the openings in the sides of the hood through which the air passes.

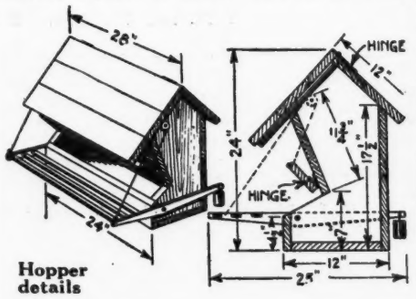
Asbestos hood lining

This inner coat will so insulate the hood from the heat rising from the motor that there will be no danger of its becoming too hot. The results will be highly gratifying and the finish will last much longer.

Self-Feeding Hopper Prevents Waste in Chicken-Yard

UNNECESSARY waste of chicken-feed may be prevented by using a self-feeding hopper such as is illustrated. The weight of the hens when they jump off the feeding perches opens the feed door. When the chickens are not feeding, the hopper is completely closed.

Twenty-four board feet are sufficient to make one of these hoppers. Two pairs of 6-in. light T-hinges, a few round-headed screws, a piece of heavy cord 32 in. long,



Hopper details

and a few sixpenny and eightpenny common and finishing nails will also be needed.

Cut the ends as shown and nail the bottom to them. Then nail on the back and front boards, notching the upper front board to take the cleats holding together the hinged top cover.

The feed cover is hinged and connected with the perch levers by cords passing over wooden pulleys 2 in. in diameter, cut with a keyhole or coping-saw and grooved with a file or chisel. Fasten these on with screws.

The perches, ⅞ by ⅞ by 24½ in., are each held by sixpenny finishing nails driven through the levers into their ends. Small weights are attached to the back of the levers to serve as a counterbalance.—M. K.

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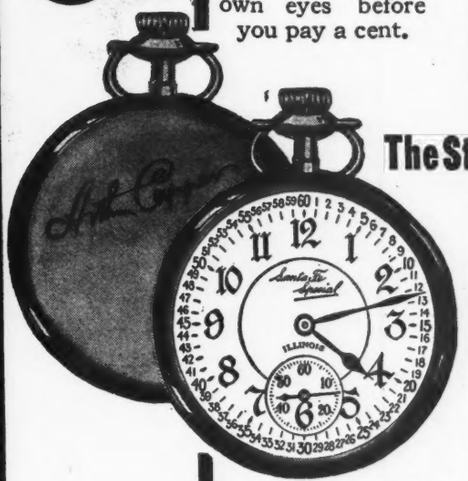

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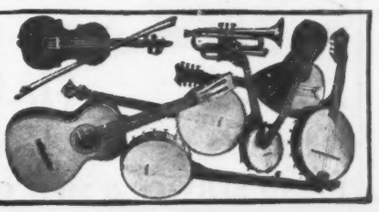

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Wireless for Everybody

The Little Wonder Portable Radio Set

that you saw in the "movies," the daily papers, etc. Simple to install and operate. Just the thing for Boy Scouts, Campers and for use on bicycles, etc. Complete in every respect and guaranteed to give complete satisfaction. Just connect your aerial ground and phones and you are ready to receive messages. Tunes to 800 meters and receives telegraph messages within 1,000 mile radius and wireless telephone messages within 30 mile radius.

Type S8 (as illustrated), with phone, price..... $12.00

Type S8A complete (incl. double headset 2,000 ohm phones, aerial, insulators and instruction book)..... 15.00

RADIO SERVICE & MFG CO.
Lynbrook, L. I.

Constructing an Electromagnetic Pump

By R. E. Nelson

(Honorable Mention in "New Uses for Electricity" Contest)

[THE possibilities for using this remarkably simple device in place of a motor to operate toys and for other purposes will immediately suggest themselves, although Mr. Nelson used the pump only on a highly specialized machine.—THE EDITOR.]

TO circulate the cutting solution on a screw-cutting lathe, the writer constructed an electromagnetic impulse pump as shown in the accompanying drawing.

A plunger operates up and down in a solenoid. Threaded into the lower end of the plunger is a small rod on the end of which is secured a piston fitted into a cylinder. To the upper end of the plunger is attached a rod made from fiber or other insulating material, which carries a brass ferrule to act as a circuit-closer, closing the circuit through the solenoid by way of two contact fingers.

This pump has only one moving part

The pump operates as follows: When the switch is open, the circuit through the solenoid is open and the solenoid will not attract the plunger, which will drop until the piston strikes the bottom of the cylinder. In this position the brass ferrule makes contact with the fingers so that when the switch is closed, the plunger is attracted upward with a quick jerk. As it moves upward, the ferrule moves with it and the circuit is broken, but the momentum of the plunger carries it up a short distance farther. The weight of the plunger then causes it to fall back until the brass ferrule again makes contact with the fingers and the process is repeated in the same way as the vibration of the armature of an electric bell as long as the switch is closed.

Two check valves similar to those employed on oil pressure lines on automobiles are on the pipe lines. These are set vertically so that they will close by gravity. When the piston rises in the cylinder, it opens the check valve and draws a quantity of liquid from the sump through the return pipe; as it descends, that valve closes and the other valve opens, and the liquid is forced upward through the delivery pipe into the tank, from which it is fed by gravity to the work. The pipes are ordinary copper tubing such as used in automobile oiling systems.

In order that the pump may operate successfully, the following precautions must be observed: The liquid must be light bodied, for if it is too viscous, the plunger will not descend but will be supported by the liquid. The pipe to the gravity tank must be short and the plunger heavy enough to return the piston to the bottom of the cylinder. The solenoid should be capable of sucking such a plunger a distance of 2 in. Its resistance should be high enough to permit its connection directly across 110 volts direct current. The bore of the cylinder should not be more than 1 in. and the stroke 2 in.

New Blueprint Service Meets with Hearty Reception

THAT the new Home Workshop blueprints fill a real need and are welcomed by the readers of POPULAR SCIENCE MONTHLY became evident as soon as the February number of the magazine was issued.

The hearty response was shown not alone by the number of requests received for the first blueprint, but also by letters indorsing the idea, extracts from two of which follow:

755 Clancy Ave., N. E.
Grand Rapids, Michigan
January 10, 1922

GENTLEMEN:

Your magazine is certainly fine and just the kind I have been wanting to get hold of for a long time. A friend made me a Christmas present of it, and he never could have given me anything that I would like better.

This blueprint service is great and I hope you will have all kinds of interest shown in it, as I want to see it continued. I hope to see in the Home Workshop from time to time an article telling how to handle tools to the best advantage and their proper care.

(Signed) A. MONTGOMERY.

Washington Junior High School
Butte, Montana
January 9, 1922

GENTLEMEN:

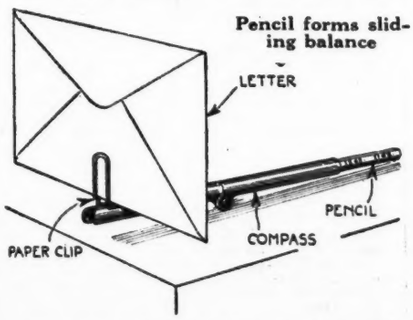
If you contemplate making a permanent mailing list, I should be pleased to have you place my name on the list, and I will forward the price of the prints as fast as they reach me.

(Signed) WM. A. GATES.

THE HOME WORKSHOP

Useful Letter-Scale Made from Cheap Pencil Compass

A HANDY letter-scale may be made with a pencil compass of the ordinary school variety, a paper-clip, and a lead-pencil. At one end of the compass the letter-clip is soldered or bound with thread

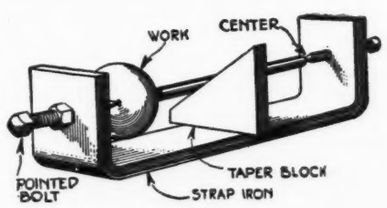


or fine wire after being bent at right angles as shown.

The readings on the hexagon pencil are determined by placing a known weight in the paper-clip. As the holder is balanced horizontally by pushing in the pencil or drawing it out of the holder, a mark is made on the pencil just at the end of the holder. The weight in ounces can then be written in ink at the right of each notch, forming a fairly accurate scale.—T. H.

Centers for Small Work

CENTERS are often needed for small jobs such as testing automobile valve-stems for trueness, for pushrods that have to be dressed, and for small armatures on which the commutator must be turned



Testing with a taper block

down. Such centers can be made by forming a piece of strap iron as shown in the sketch and fitting it with two pointed bolts.

When the centers are adjusted to the desired position, they may be locked by tightening the locknuts. A taper block will prove very handy when testing for trueness.—S. E. GIBBS.

Simple Monoplane Glider

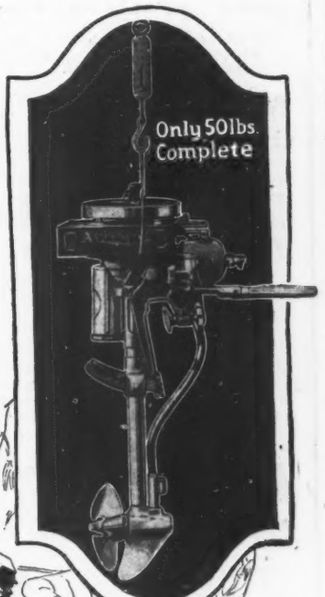
COMPLETE working drawings and directions will be given in the April POPULAR SCIENCE MONTHLY for making a glider with 30 ft. wing spread and full airplane controls. The glider was designed especially for the Home Workshop and is the best all-around model that has been developed since gliding became a popular sport. The construction has been so simplified that the average home mechanic can easily build it at little cost for materials.

No Heavier than a Good String of Fish

FOR you outdoor men and women, whose playgrounds are the lakes and streams of many States brought within easy reach by motor car, train or trolley—for you has been designed and perfected this lighter, more portable row-boat motor—the Evinrude "Lightweight."

Weighing not quite 50 pounds, **complete**—21 pounds less than the Standard Evinrude—this new sport model is the lightest practical outboard motor made. Weight has been saved and strength maintained by replacing many bronze and malleable parts with aluminum alloys.

Practically the counterpart of the Standard 2 H. P. model in design, and its equal in power and speed, the "Lightweight," though not intended for such rugged service, is a motor entirely worthy of the Evinrude name.



See these Evinrude motors at your sporting goods or hardware dealers. Or write for catalog and new prices (recently cut to prewar level).

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has blazed the way with everything worth-while and dependable in radio. This catalog eclipses all previous editions. It is all other catalogs in one. No other is even half as large. The complete catalog of the Radio Corporation, with a wealth of scientific data and diagrams, showing how to build powerful radio telephone transmitters, the Remler, Murdock, and in fact all other catalogs, are in this catalog. Over 50 pages of diagrams and data on radio.

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In answer to a request from Chief of Police, Warren Biglow, the Finger Print Expert, arrived at the scene of the daring robbery of the O— Company offices. $6500.00 in currency was gone. Not a single clue had been found.

Almost immediately Biglow turned his attention to a table which had been tipped up. The glossy mahogany showed an excellent set of finger prints. *The thief might just as well have left his calling card.*

To make a long story short, his prints were photographed, and matched with those of "Big Joe" Moran, a safe blower. Moran was caught and convicted on Biglow's finger print proof. The money was recovered and a $500.00 reward given to Biglow, in addition to his fees—as pay for his two hour's work.

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THE HOME WORKSHOP

Amuse the Little Ones with a Cigar-Box Jumping-Jack

CIGAR-BOX wood and a sharp penknife are the essentials for making this amusing little jumping-jack. Make parts for the front and back of the body, two arms, two legs, and two feet, drawing them carefully on the wood and coloring them before they are cut.

The jumping-jack jumps

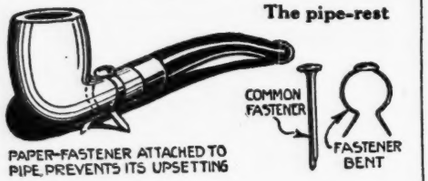
Bore holes in the feet and fasten them loosely to the legs with brads. In the same way attach the arms and legs to the body, so that they all move easily. Then connect the two arms and the two legs together with cross strings and tie a long string to the centers, as shown, so that a pull will make the figure lift its arms and legs as if dancing.—E. BADE.

Assembling the parts

To Prevent Pipe from Tipping

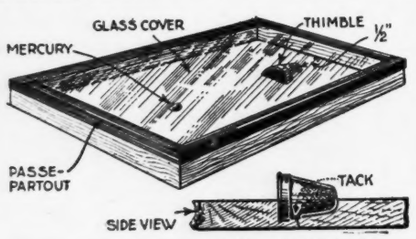
ANY one who smokes a pipe knows how annoying it is to have the ashes spill from the bowl when the pipe is laid on its side. This is especially annoying to a person who does any great amount of writing, as the ashes will invariably get all over his papers. This may easily be avoided as shown in the illustration. All that is needed is a brass paper-fastener bent into the proper shape.—W. W. PARKER.

The pipe-rest



An Amusing Mercury Puzzle

IF a steady hand indicates steady nerves, this puzzle will afford an amusing test. The bottom of a shallow cigar-box is covered with a sheet of highly glazed cardboard. A small thimble (the smaller the better) is sunk in the wood so that its lower edge is flush with the floor of the box.



Try to put the mercury in the thimble

This can be done with a knife and the cardboard trimmed neatly around the thimble.

Sufficient mercury to fill the thimble half full is placed in the box and a sheet of glass is passe-partouted on top to serve as a cover. The object of the game is to get the mercury into the thimble.—H. F. G.

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Just send your name and address. The watch, chain and knife come to you, prepaid. Give the expressman $8.50 as a deposit. If after 10 days, you do not wish to keep them, return at our expense; your deposit will be refunded instantly. Trial is absolutely free. If you keep the watch pay $3.40 a month until full price of $42.50 is paid. This splendid watch will cost you less than 11c a day. Act at once. Write for your free copy of de Luxe catalog of Diamonds and Jewelry. Address **Dept. 472-H.**

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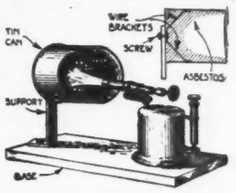
THE HOME WORKSHOP

How to Make a Heat Intensifier for a Blowtorch

A HEAT intensifier for a blowtorch may be made easily and will prove a handy tool for hardening, tempering, and experimenting. All that I had to buy when I made one was 2 lbs. of ground asbestos, such as is used in covering heating pipes; it cost 20 cents at a plumbing-supply house.



Fro hardening and tempering

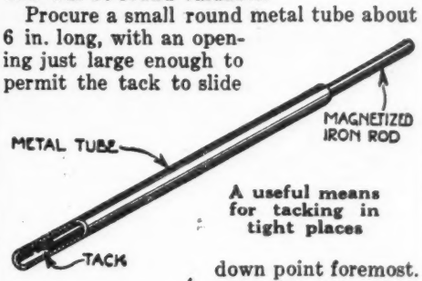
The main support is made of steel or cast iron and is as high as the burner of the torch. One end is fastened to a baseboard with one screw, permitting it to swivel. A tin can is partly cut away on one side as shown. Wire brackets are soldered to the bottom of the can to support the asbestos, and the can is bolted to the top of the support.

The asbestos is mixed and plastered around the bottom and sides of the can, and a pocket is formed in the thickest part of the asbestos. The intensifier should be laid aside for two days to dry.—A. R. G.

Magnetic Tack-Driving Tool

FOR driving tacks in places where a hammer is difficult to use, the following tool will be found valuable.

Procure a small round metal tube about 6 in. long, with an opening just large enough to permit the tack to slide down point foremost. Into this tube slip a steel or iron rod 8 in. long and slightly smaller in diameter.

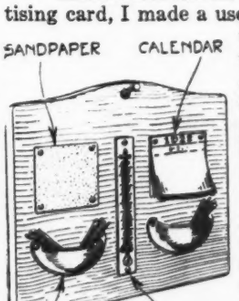


A useful means for tacking in tight places

To use the tool, put one tack in the tube, place it in position and insert the rod. A few hammer blows on the rod will drive home the tack.—S. S. SUTHERLAND.

Drawer-Pulls for Match-Holders

WITH two old drawer handles and a small thermometer cut from an advertising card, I made a useful and ornamental match-holder to hang beside my desk. I attached the pulls to a stiff piece of cardboard by small brass paper-fasteners.



Matches, thermometer and calendar

A strip of sandpaper and a small calendar were fastened just above each handle, with the thermometer mounted in the middle. A picture may be used in place of the thermometer.—LEIGHTON POWELL.

[This design might be varied so that the sandpaper is below the match receptacle to avoid all danger of the matches being accidentally ignited.—THE EDITOR.]

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Take it in your hands —give it a quick twist or turn that would snap an ordinary blade—you'll find out what Atkins has done in making a "non-breakable" hack saw blade.

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Atkins hack saw blades will save you time, money and labor. Prove it by sending your name and address with ten cents for a sample eight or ten inch blade, stating the kind of material you are cutting. If it is not the best blade you ever used, we will send your money back.

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A BETTER SAW FOR EVERY USE

No matter what kind of saws or saw machinery you need—for metal or wood cutting—it will pay you to know the savings in time and labor—the increased efficiency—the longer life and greater value of Atkins Products.

Send for These FREE Booklets

"Atkins Metal Saws," "Kwik-Kut Metal Cutting Machines," "Hack-Saw Blades and Frames," "Metal Band Saw Blades and Machines." Just fill in your name and address and the use you make of the saw—below and mail it—NOW.

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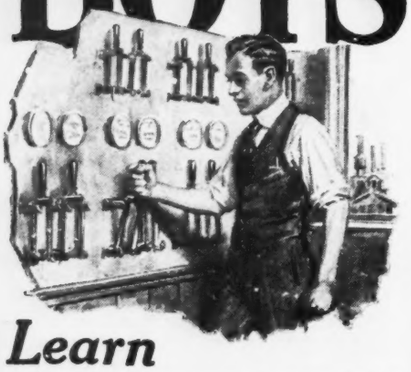

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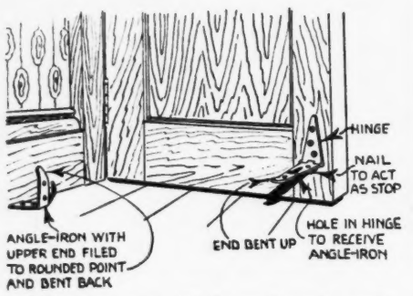
THE HOME WORKSHOP

Strap Hinge and Angle-Iron Form Useful Door-Catch

TO make this cheap and effective door-catch, which will serve well in any place where a neat appearance is not essential, merely a small strap-hinge and an angle-iron are required.

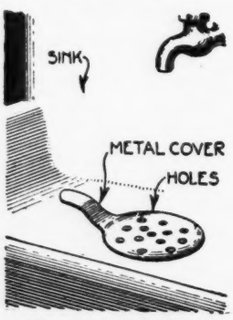
Curl up the point of one strap of the hinge and cut a hole in it as shown, a trifle


HINGE
NAIL TO ACT AS STOP
ANGLE-IRON WITH UPPER END FILED TO ROUNDED POINT AND BENT BACK
END BENT UP
HOLE IN HINGE TO RECEIVE ANGLE-IRON

This stop costs little and works well

wider than one end of the angle-iron, which should be pointed and bent back a little. Then attach the hinge and angle-iron so that the hole in the first will engage the point of the second. Place a nail or screw under the movable leaf of the hinge to keep it horizontal.—L. B. ROBBINS.

Trap for Kitchen-Sink Drain

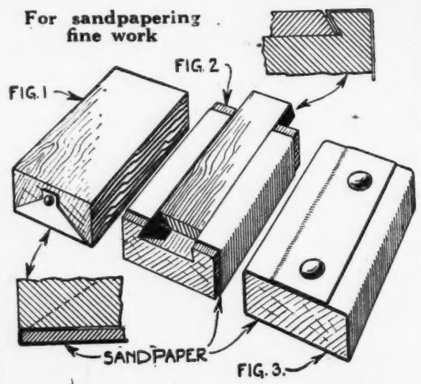


The cover in place

REMOVING refuse material from the kitchen sink will be easier and less unpleasant if a cover for the drain is made as shown in the accompanying illustration. A strip should be bent up to serve as a handle and as many holes should be drilled in the cover as there are in the sink drain over which the trap fits.—THOMAS SHEEHAN.

Neat Sandpaper Blocks

THREE neat ways of mounting sandpaper are illustrated. They are intended for the use of home workers and



mechanics who have much sandpapering to do on small, fine work, and who therefore require a method of attaching sandpaper to a small block that will be less cumbersome than usual.—W. C.

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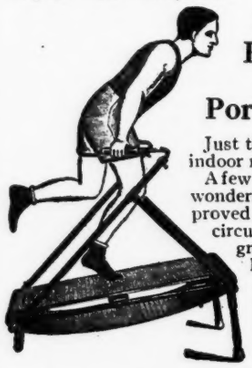

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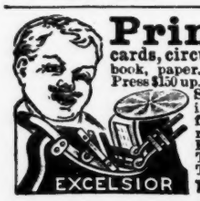

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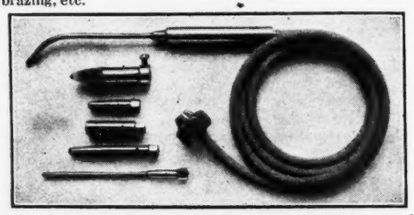

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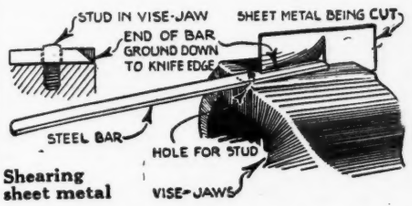
THE HOME WORKSHOP

How to Make a Shearing Tool for Sharp-Jawed Vise

DRILL a ¼-in. hole about 2 in. from one end of a flat piece of ⅛ by ¾ in. tool steel, about 1 ft. long. The short space between the hole and the end of the steel



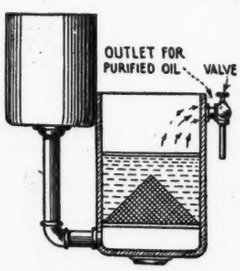
Shearing sheet metal

bar is ground to a knife edge in the manner shown in the end view.

In one corner of the vise-jaw drill and tap a hole to receive a threaded ¼-in. pin. Leave about ¼ in. of the pin projecting. The steel bar is slipped over the pin with the cutting edge toward the opposite vise jaw, which must, of course, be fairly sharp.—FRANK L. MATTER.

To Cleanse Used Oil

OIL drained from the automobile crank-case and transmission may be cleansed in an oil strainer that will filter the dirt and foreign matter from the oil and make it usable in lubricating springs, brakes, etc.

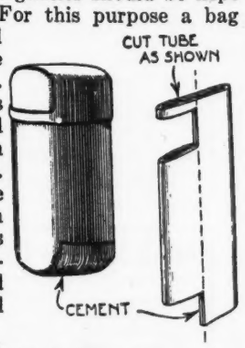


Construction of strainer

The oil, put into the tank, flows down the outlet pipe and then forces its way up through the fine-wire-mesh screen shown on filter tank at the right. This screen is set in a hoop, which permits its removal for cleaning, and the cloth screen above is also set over a hoop so that it can be changed if clogged. A receptacle is placed under the outlet of the second tank to receive the purified oil, which will rise to the top. This oil filter can be made in any dimensions.

A Bag for the Spare Tube

THE extra inner tube that the motorist carries for emergencies should be kept clean and dry. For this purpose a bag made from an old inner tube will be found very useful. The old tube is laid on a table and cut as shown in the illustration. After cutting, the tube is folded on the dotted line as shown. The lower portion should be turned over and cemented.



Made from inner tube

An old razor-blade will cut the rubber easily if the rubber is kept wet with water. This bag makes a neat compact bundle, and will not chafe the good tube.—R. H. KASPER.

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YOU CAN OWN This Complete WIRELESS TELEPHONE and Telegraph Receiving OUTFIT For $15.00

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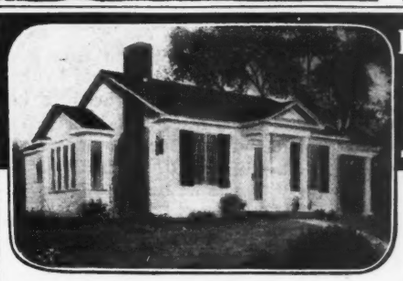

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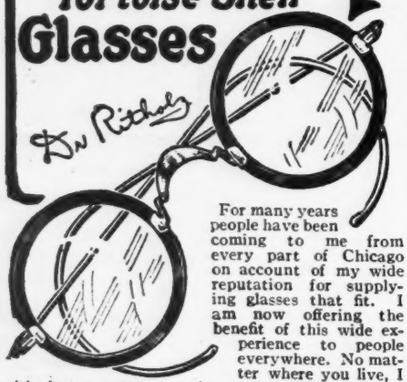

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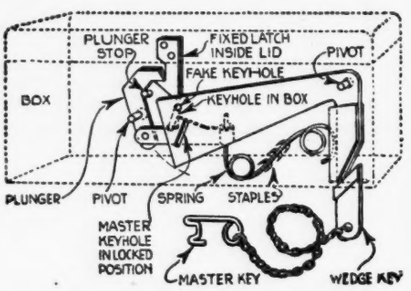
The box is automatically locked when the lid is closed. A small false keyhole in the inner mask ordinarily appears in the center of the slot-like keyhole in the box itself and gives the impression that a small straight key of some kind might open it. The real key, however, will not enter, until another wedge-shaped key has been pressed into a slot in the bottom of the box in order to move the J-shaped inner mask in such a way as to bring a slot in it directly opposite the keyhole slot.

When the key is in the lock, it is turned to the left to disengage the catch. This



Lock mechanism and the two keys

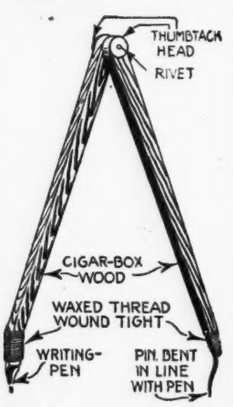
key should be made of heavy wire in the shape illustrated while the bottom key is like a wedge.

The parts of the lock may be made of well seasoned hard wood or of heavy sheet brass or copper. If made of metal, extra pieces should be soldered at the edges where one part works against another. All should be perfectly smooth.

The lock is assembled on a board of a size to fit neatly into the box. When it works perfectly, cut a keyhole in the outer wall of the box to register exactly with the keyhole in the inner mask, when the latter is in position for opening. Also drill a hole through the mask so that when the box is locked, this false round keyhole will show in the center of the box keyhole. The fixed latch inside the lid is not placed in position until after the lock has been installed.—LEROY CRIGLER.

Making an Emergency Compass

THE occasion for making this emergency compass was very urgent, for the draftsman had dropped his own compass on the floor, stepped on it, and ruined the pen beyond repair. The mishap occurred in the country, when a new part could not be had at any price. So this compass was made and the tracing was thereby finished on time.—B. R. WICKS.



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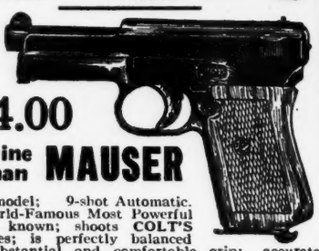

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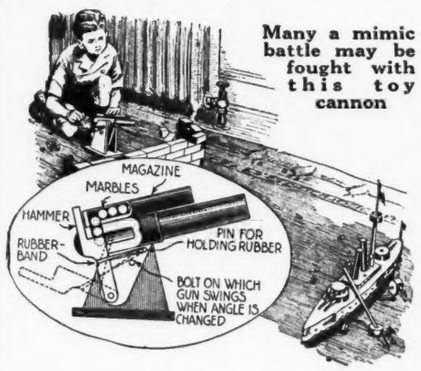
THE HOME WORKSHOP

Rapid-Firing Toy Cannon Shoots Marbles

THIS cannon, which shoots marbles, is a toy that is in outward appearance very realistic. It is made entirely of wood and a heavy rubber band provides the power. The missiles can be thrown from ten to a hundred feet, the distance depending entirely on how far down the hammer is drawn.

The barrel and magazine are turned from solid pieces of wood and bored to allow free passage of the marbles. The boring stops before it reaches the breach of the barrel. Another hole is bored through from the side, meeting the first one at right angles. At this point the marbles drop in from the magazine, which is bored similarly. The hammer is less in thickness than the diameter of the marbles. It is admitted into the



Many a mimic battle may be fought with this toy cannon

breach through a slot just wide enough to accommodate it but not wide enough to allow a marble to drop out. The hammer pivots on a pin between two triangular-shaped pieces of wood that are fastened directly to the sides of the cannon. These pieces have holes drilled through them for the pin that secures the rubber band as well as for a small iron bolt. The gun swings up and down on this bolt and the whole unit is fastened to the base by means of it.

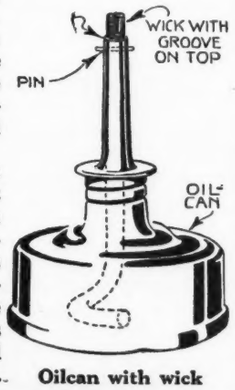
When the hammer is drawn back, a marble drops from the magazine into the barrel, and when the hammer is released the marble is struck a sharp, quick blow, which drives it from the muzzle. Each time the hammer is drawn down, another marble drops into place.

Care should be taken not to give this cannon to children who cannot be trusted to respect their neighbors' windows.—E. G. G.

An Oiler for Your Razor-Blade

A RAZOR-BLADE always works more smoothly when it is covered with a film of oil. It is easy to keep it oiled if the spout of an ordinary oilcan is cut off and fitted with a round wick as shown. The blade is drawn through a groove at the top of the wick, which is always saturated with oil.

Microscopic rust spots are almost certain to form on razor blades unless precautions are taken to prevent them. The best preventive is a film of good quality oil.—D. C.



Oilcan with wick

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Tom Brown as he appears in "Tip-Top"

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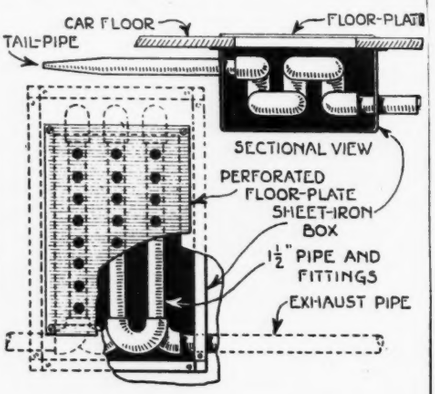
THE HOME WORKSHOP

How to Make a Combined Muffler and Car-Heater

STARTING a car in cold weather is especially hard on the muffler and sometimes muffler shots demolish the muffler shells. An arrangement that is not easily damaged unless through a collision or accident may be made by assembling short sections of pipe such as are used by plumbers for waste pipes, fairly thin-walled. These can be connected with couplings and



This muffler also warms the car

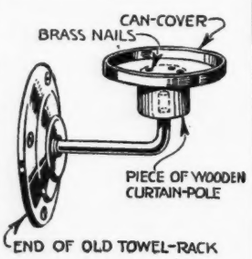
secured on the end of the exhaust pipe to replace the muffler. Six or eight sections make a muffler as efficient as the usual type bought.

An advantage afforded by the use of these pipes, as shown in the illustration, is that the heat may be directed into the car through a perforated cover.

This arrangement does not encroach upon the foot room, and in the summer the perforated section can be covered with a piece of sheet iron and the sheet-iron box cover about the improvised heater muffler removed to avoid unduly heating the floor.—G. A. L.

A Neat Glass Holder

THIS glass holder was made with one end of an old towel-rack, a section of curtain-pole, and an aluminum can cover. The cover was fastened to the wood with three brass nails. Water can be removed from the cover by lifting the holder off the rod support.—D. W. C.



Holder made from odds and-ends

Save Your Hands with Soap

WHEN about to do painting or any dirty work, you can protect your hands by a simple method. Moisten common soap and work it into the pores, around the cuticle, and under the fingernails. In about a minute your hands will be dry and you will be ready for work.

After the job is done the hands can easily be cleansed. I have made use of this application for many years while working on my automobile, and as a result have always kept my hands in good condition.—F. W. ERDMANN.

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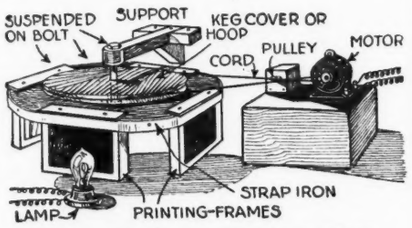
Electric Machine for Making Photographic Prints Rapidly

IF one is pressed for space, lacks time, and often has to run off large batches of photographic prints, this machine will be a money-saver. When properly set it will also insure more uniform printing and fewer discards.

The printing-frames drop into slots in a revolving disk of wood, which should be about 2 ft. in diameter for handling post-card sizes. A small motor turns the disk and presents each frame in turn to a frosted 40-watt bulb. Variations in speed may be made by changing the lamp or placing a larger pulley on the motor.

The disk is made of several boards cleated together and cut with a keyhole saw. The



Each revolution makes four prints

spaces for the frames are then cut at equal distances apart in the edge and a piece of strap iron or heavy galvanized iron is nailed around the rim.

The motor pulley should not be more than ½ in. in diameter, unless the motor runs slowly. The guide pulley prevents the belt, which is stout cord, from jumping off the motor pulley; without it, the motor would have to be farther from the machine.

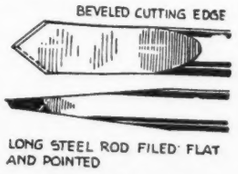
Strips of sheet iron are fastened to the printing-frames with screws as illustrated, and a screw-eye may be placed in each to serve as a handle, provided it does not interfere with the driving-cord.

To operate, start the motor, turn on the light, and remove from the disk the frame that is approaching. Place negative and paper in it and drop it back in its slot, which should not have traveled more than one sixth of a revolution. As the next frame approaches, repeat the process.

The baths must be prepared beforehand and it will be well to have a rinse bath with running water, or, better still, have a helper to take the prints after coming from the frames. This will prevent developer getting on the unexposed paper. As the operations become mechanical, the speed may be increased.—DALE R. VAN HORN.

Drilling Deep Holes in Wood

SMALL twist drills are easily broken when used for boring deep holes in wood. When it is necessary to do drilling of this nature, it is better to make up a set of drills of plain steel rod, not hardened. The rod is cheap and a drill can be made in a few minutes by simply filing or grinding the end flat and pointing it. Such drills do not make as clean and smooth holes as the regular drills and they are good for wood only, but for this special purpose they are exceedingly satisfactory.—H. G.



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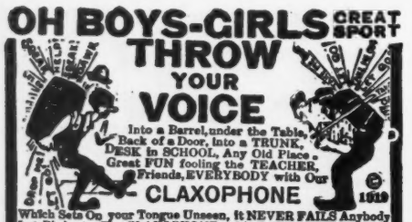

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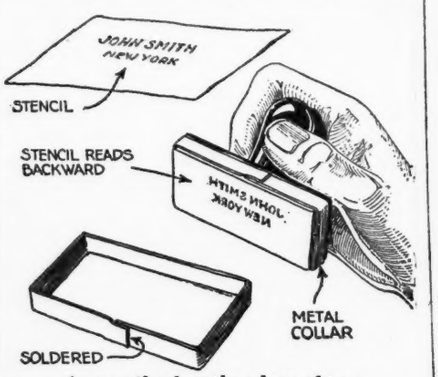
THE HOME WORKSHOP

How to Make Your Own Self-Inking Stencil Stamps

OFTEN the expense of having a rubber stamp made may be saved by making stencil stamps on your own typewriter. They are easily prepared after you have provided yourself with a holder.

Select an ordinary rubber-stamp holder with a flat, smooth face if possible, although



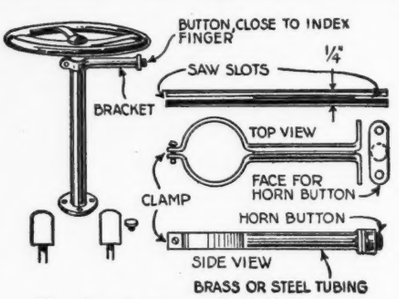
A stencil takes the place of type

the channel type will do. Cut pieces of flannel and linen or muslin to fit over the face of the holder and bend a strip of 3/8-in. wide tin or brass to form a collar for clamping the cloth and stencil to the frame. Solder the ends together.

The flannel is placed on the holder and inked uniformly with a regular mimeograph ink, and the linen (or muslin) piece is laid smoothly on top. Then make a mimeograph stencil on the typewriter in the usual way and fasten it to the holder with the collar. After any excess of ink has been wiped off with a slightly dampened cloth, the stamp will make good, clear impressions.—L. POWELL.

Bracket for Horn-Button

THE horn-button on a Ford or those on other cars are readily made more accessible by means of the simple attachment shown in the illustration. This attachment consists of a section of thin brass or steel pipe cut open at the ends and fastened to the steering-post by means of the clamp thus formed. The length of the bracket



How bracket is made and attached

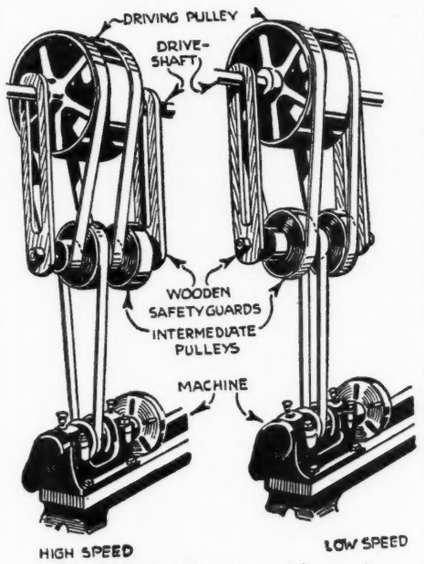
extension should be about 6 in. so that the index finger of the right hand can reach it while the palm of the hand is on the steering-wheel. The pipe is split open with a hacksaw and the ends are spread. A stove-bolt clamps the bracket to the post. Two holes drilled through the other end are for screws to secure the horn-switch. This bracket is adaptable to either a circular or oval post and is adjustable sidewise or up and down to the position most essential for quick operation.—G. A. L.

THE HOME WORKSHOP

Novel Method of Belting Small Machines for Two Speeds

THE accompanying picture illustrates a novel method of speed changing. The drive pulley is wide enough to accommodate two belts and still leave a blank space between them wider than the width of the belt. Two small pulleys of equal size and two large pulleys of the same diameter are placed alternately on a short shaft. The two belts on the drive pulley lead to two of the pulleys on the short shaft, leaving a pulley between them, which is belted to the machine. One pulley on the short shaft always runs minus a belt.

The drawings show two arrangements to drive the machine at two different speeds.



The belt lengths are unchanged

The intermediate pulley virtually revolves in the air, as the pull of the belts retains it in position. Should a belt break, the balance is destroyed and the pulley will fall. For this reason it is well to furnish safety guards. These consist merely of two strips of wood in which the intermediate shaft revolves freely. The ends that pass over the drive-shaft should be slotted to permit the intermediate pulleys to change their position.

This method is not recommended for heavy work, but it is effective for light driving.—R. H. KASPER.

Copy- or Proof-Holder

THIS copy- or proof-holder was found to be very useful in a lithograph shop. It is quicker than the thumb-tack method of fastening copy and also replaces the usual makeshift easel, which is always in the way. It would be valuable in any workshop for holding drawings.

A useful clipboard

The construction is so clear in the drawing as to be self explanatory. A piece of old clockspring or other flat spring holds the clip closed.—D. W. CLARKE.

WANTED IDEAS

Inquiries from Manufacturers and Others Who Are Looking for Good Ideas

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are constantly being received. Manufacturers are always interested in any new device for which there is a market, which fills a long felt need, which makes production possible at a lower cost, or which will do the work BETTER. Extracts from some of the more recent letters received are printed herewith. There is undoubtedly a great demand to-day for really worth while inventions.

Can You Help?

Here are abstracts from a few recent requests I have received from those who wish to buy, finance or manufacture good inventions. Have you an idea that will fill the bill?

Following is an extract from letter dated July 20, 1921, from a middle western manufacturer whose volume of business last year was approximately $1,000,000. "If you are in touch with any meritorious proposition seeking manufacturing facilities, in the automotive or some other good field, we shall be glad to have you place us in touch with it. We are willing to consider outright purchase of patents or manufacture upon a royalty basis."

Another request from a large corporation, dated June 27, 1921, follows: "Should you have clients whose inventions are worthy of commercial manufacture and exploitation, we shall be glad to consider the financing of such projects, if they are interesting. In that event, we indicate also that we are identified with two large machinery manufacturing plants located, respectively, in Bridgeport, Ct., and Providence, R. I. These plants, besides having their own foundries, are thoroughly equipped to manufacture anything from a small lathe to a complete automobile. Whether your clients have mechanical inventions or otherwise, we shall be pleased to hear of any proposition requiring financing."

Another letter dated April 28, 1921, from a large corporation whose officers include some of the best known men of the country, says in part: "We are in the market for an invention of merit possessing undoubted economic and commercial value combined with ADEQUATE PATENT PROTECTION."

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THE HOME WORKSHOP

Small Electric Lamp Warms Water for Poultry

NOT only should drinking water intended for poultry be kept from freezing so that the hens can drink at all times, but, according to scientific poultry-raisers, it should also not be cold enough to chill the birds. Both requisites may be provided for by the use of this inexpensive electric water-warmer.

An ordinary pail or pan may be used with the addition of a large tin can or small pail for the heating unit. If made of galvanized iron, the parts will last longer.

Warm drinking water often means more eggs

Arms riveted to the can extend over the edge of the water-pail. Care must be taken to solder around the rivet holes on the outside, for the lamp-container must be water-tight.

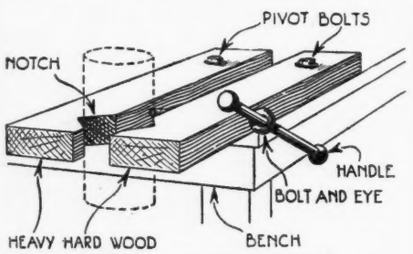
An ordinary metal lamp socket is soldered or crimped into a tin disk large enough to cover the container. This cover must be either a tight-fitting lid or be made to fasten with a spring or catch.

In all but the coldest weather a 15-watt lamp will warm a 10-quart pail sufficiently. Operating 24 hours a day with current at 10 cents a kilowatt hour, the warmer will cost 3.6 cents, which is worth while if it adds only two eggs a day to an otherwise doubtful cold-weather production. In severe winter weather, it may even prevent the loss of some of the hens.—J. H. V.

A Vise for Carburetor Bowls

FOR holding carburetor bowl, muffler shell, speedometer heads, and like thin body stock, I use a pair of giant gripping hands.

These are made of two pieces of hard wood 3 by 4 in. and a threaded eye-rod



This clamp grips firmly without damaging

and nut for the gripping screw. The two pieces are bolted to the top of the bench so that they can be swung back out of the way when not in use, by removing the nut from the eye-bolt and sliding the rod out of one of the pieces.—G. G. McVICKER.

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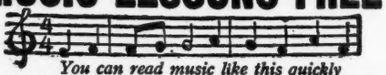
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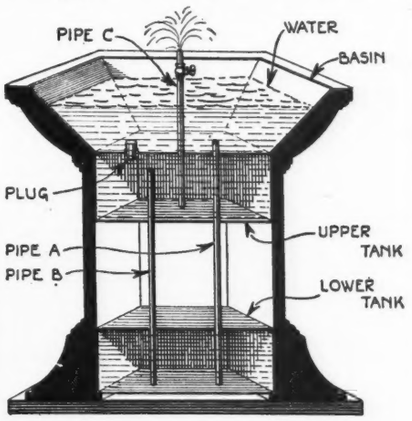
THE HOME WORKSHOP

Ornamental Table Fountain Does not Require Running Water

THIS self-acting fountain, which will play for a long while without attention, makes a novel table decoration.

Two tanks of the same size and a basin that holds rather more water than either are combined as shown. The arrangement of the pipes can easily be followed in the



An adaptation of Hero's fountain

diagram. The pipe *C* has only a very small hole in the top.

To operate, put a plug in the top of pipe *A*, take out the basin plug, and fill the upper tank. Replace the plug and fill the basin also. Pull out the plug in pipe *A*, and then the water will rush down that pipe into the lower tank, up through pipe *B* into the upper tank, and finally up through pipe *C*, falling in a spray. The process will be repeated automatically.

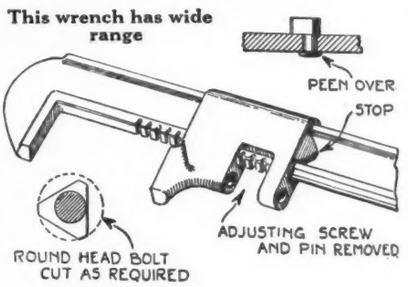
The fountain may be provided with any suitable ornamentation in plaster, wood, or metal.—E. A. McCann.

Increasing Wrench's Capacity

THE usual adjustable wrench supplied in the average automobile tool-kit is of too limited capacity to turn large couplings or nuts, as on the exhaust pipe, or water-pump glands, and similar parts.

To avoid carrying more tools and to save the cost of extra wrenches, one motorist altered the adjustable wrench in his tool-kit in the manner illustrated. He drilled a

This wrench has wide range



hole in the handle and inserted a round-head bolt, with the sides of the head cut flat, so that the adjustable jaw of the wrench could bear against them when the adjusting screw had been temporarily removed. On some wrenches it is not necessary even to remove the screw.

Each side of the bolt-head was cut differently to give a certain amount of adjustment. Care must be used not to overtax the wrench when using the largest openings.—G. A. L.

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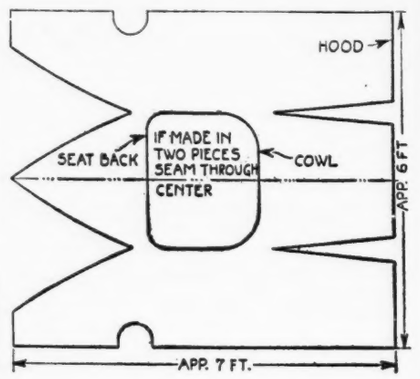
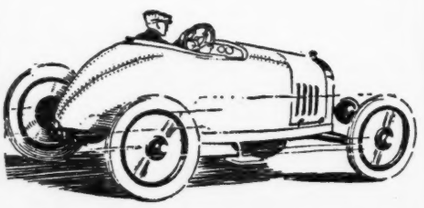
THE HOME WORKSHOP

Pattern of One-Piece Speedster Body Design

THE construction of a speedster body should be of utmost simplicity, otherwise the work involved exceeds the ability of the average builder with his limited tool equipment. For the builder who desires to obtain the utmost in appearance with the least work, the one-piece design illustrated in the picture is the best to select.

The cowl, rear deck, and side body are cut from sheet metal about 8 ft. long and 6½ ft. wide. This is wide for thin material and it may be desired to seam two sections





This pattern has long, sweeping bends

through the center before drafting and cutting out the form.

This design will allow of a streamline body and the hood edge can be made as required to conform to the hood or engine cover installed on the car. No opening to the rear compartment is provided from the rear, but access is permitted by making the seat backs in one piece and removing these.

The edges of the metal can be joined by either an angular section soldered to the inside edge or riveted along the edges. The illustration shows only the general form for any car and it is necessary to work out the proportions to fit the chassis frame and hood.

The main consideration in this pattern is that no difficult bends are required, and where the metal is bent, the long sweeping bend is used. The average home-constructed job involves short and difficult bends. These invariably show defective workmanship.—G. A. LUERS.

AN old inner tube is to the motorist what bailing wire is to the farmer. He uses pieces of it to protect his distributor cap, ignition wires, and battery from dirt and dampness. A strip takes the place of a carburetor choke spring in an emergency. On some cars pieces will do for temporary hose connections, fan belts, and gaskets.

Tacked around pedal slots the rubber will prevent drafts, and cemented to the pedals themselves it may at some time prevent a bad accident. Rattles may be diminished temporarily by wedging in wads of rubber.—P. R. J.

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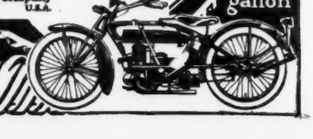

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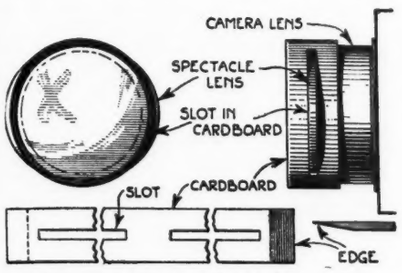
THE HOME WORKSHOP

Taking "Close-Ups" of Objects with an Ordinary Camera

I RECENTLY had occasion to photograph a 10-in. statue on a 4 by 5 in. plate and found that my portrait attachment gave an image occupying only about a fifth of the plate's surface.

In order to obtain as large an image as the plate would hold, I secured an ordinary spectacle lens, the magnifying power of which was half again as great as my portrait lens. This was attached in place of



How extra lens is attached to camera

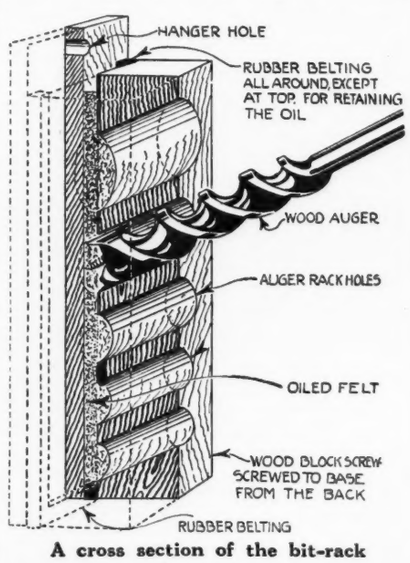
the portrait lens by means of a strip of cardboard in which two slits were cut. This strip was sufficiently long to encircle the regular camera-lens mounting and to lap for gluing.

To those who like to keep photographic notes and references of small subjects such as plants, coins, and the like, this idea should prove useful as well as economical.—HAROLD M. STOWELL.

A Self-Oiling Bit-Rack

TO make this auger bit-rack, select a piece of soft "two by four" and bore into it a series of holes at an angle. Each of these should be a trifle larger than the bit it is to contain.

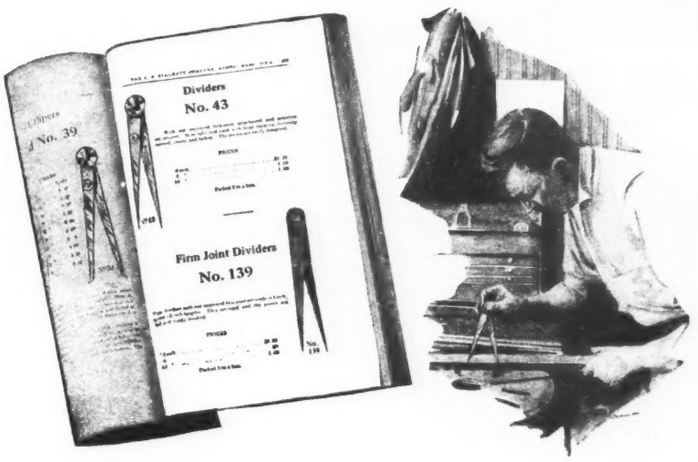
A piece of felt is then cut somewhat smaller than the block to serve as an oil pad. To prevent any surplus oil from


HANGER HOLE
RUBBER BELTING ALL AROUND EXCEPT AT TOP, FOR RETAINING THE OIL
WOOD AUGER
AUGER RACK HOLES
OILED FELT
WOOD BLOCK SCREWED TO BASE FROM THE BACK
RUBBER BELTING

A cross section of the bit-rack

escaping, a piece of belting is cut out so that the felt will fit into it, as in a frame. Fasten the thin backing piece to the block with brads, the felt and belting being clamped between. The belting can then easily be trimmed off to the same size as the block. Oil is applied to the felt through an opening in the belting at the top, slowly filtering through.—LOUIS SCHNEIDER.

New Tools You Should Know



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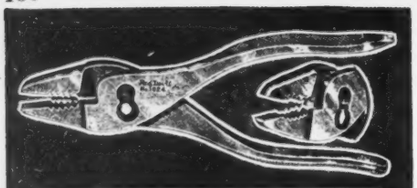

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THE HOME WORKSHOP

Prepare for Spring Gardening by Making This Wheel-Hoe

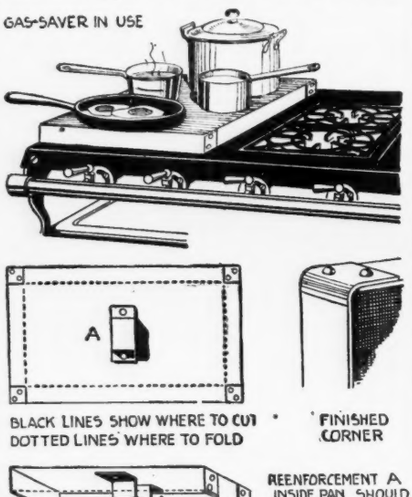
MUCH backbreaking labor in the garden can be saved with a wheel-hoe or cultivator such as is illustrated. It was made of ⅞ by 3 in. strips of wood bolted together, with an old wheel and a blade that was made by a blacksmith at small cost. The handles are 57 in. long, the horizontal members 22½ in., the vertical members 18 in., and the cross pieces 8½ in. The blade is screwed to the vertical members. Pieces of bicycle tires make good grips for the handles.

The wheel-hoe

This wheel-hoe has been used for two years and is today as good as it was when made.—JOHN NEUERBURG.

Saving Gas in the Kitchen

THIS gas-saving device may be made to cover two or four burners of a gas-plate or -range. If the sheet metal available is not heavy enough to support the weight of the cooking utensils without sagging, a reenforcement should be provided as shown, riveted to the center of the pan. The drawings are self explanatory.—L. C.

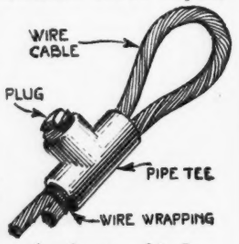

GAS-SAVER IN USE
A
BLACK LINES SHOW WHERE TO CUT
DOTTED LINES WHERE TO FOLD
FINISHED CORNER
A
REENFORCEMENT A INSIDE PAN SHOULD NOT BE HIGHER THAN DEPTH OF PAN.

Making two burners serve as four

How to Make Wire Cable Eyes

TO put an eye in an end of a cable by splicing is an art that takes practice and patience. The illustration shows a practical substitute. A pipe tee and pipe plug of suitable size are used as a coupling and binder.

The loop of the able is caught in the tee and the plug is screwed down as tightly as possible. An additional seizing can be made of wire on the two parts in front of the tee.—R. N.



A pipe-tee binder

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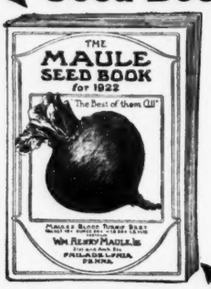

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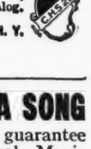

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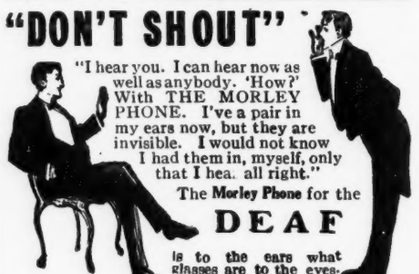

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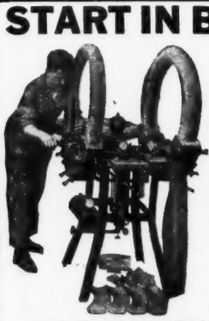

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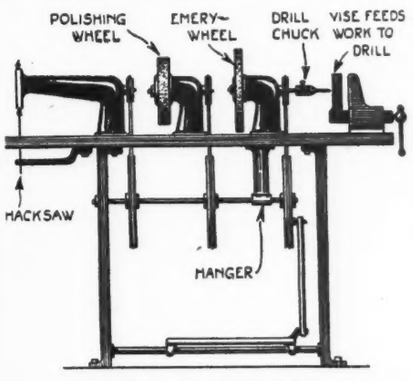
Building a Foot-Power Machine for Light Work

OLD sewing-machines, which usually may be obtained at small cost from junk dealers, will make a useful small combination footpower machine for the home workshop or for a repair-shop. At a cost of less than $5, the writer has just completed one that is a miniature machine-shop in itself—a hacksaw, jigsaw, emery-grinder, polishing-wheel, drill-chuck, and vise.

Obtain one sewing-machine frame with foot pedal and driving-wheel complete and three or more old machine heads. Mount a heavy plank top on the frame and fit up the machines as shown in the illustration.

The first will operate a hacksaw or fret-saw blade, clamped to the needle-shaft



A machine-shop in miniature

after the presser-foot has been removed. The blade passes through a slot in the table and is attached to a spring underneath.

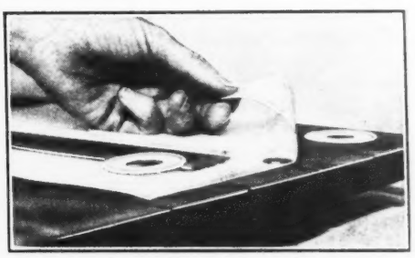
The second head is sawn off near the pedestal, as shown, the shaft shortened and a bearing made of Babbitt-metal. The wheel is wood, covered with fine emery-cloth.

The third head is mounted in the same way and drives an emery-wheel. Into the other end of the spindle a drill-chuck is screwed. The work is held against the drill and fed to it by means of an ordinary bench vise. The end of the slide bar of the movable jaw will serve to press the work against the drill if the vise is mounted at the right height; and the vise itself will still serve for light work, or even for heavy work, if substantial bench legs are placed beneath it.

In remodeling the frame below, a hanger was provided for the long drive-shaft and the crank wheel turned around so that the driving crank is outside.—R. E. LEIBE.

Thumbtack Pads for Draftsmen

DISKS of blotting-paper with the centers rem ved may be placed under the drawing-paper beneath the thumbtacks



How the pads are used

in such a way that the heads of the tacks will not project above the surface.—K.H.H.

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Performance counts—when you've a Veeder Counter on your machine! Counts so you can watch it and *develop* it.

The record of a Veeder Counter may show satisfactory efficiency in a machine, or it may show merely a good *beginning* in mechanical development.

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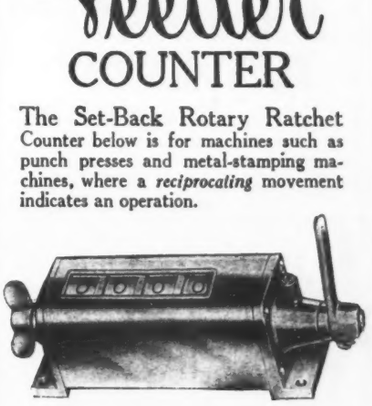
Veeder COUNTER

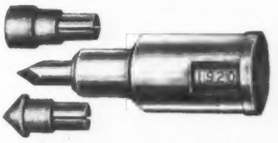
The Set-Back Rotary Ratchet Counter below is for machines such as punch presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. *(Cut less than ½ size.)* Set-Back *Revolution* Counter of similar model, $10.00 (list).

Speed Counter

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel. You hold the tip of the counter against end of revolving shaft; press lightly when the second hand of your watch comes to 0; release pressure when minute is up.



(Cut less than ½ size.)

The Veeder Speed Counter enables you to keep motors, engines, generators, line shafting and machines operating at **efficient speeds.** Price, with two rubber tips (as illustrated) $3.50.

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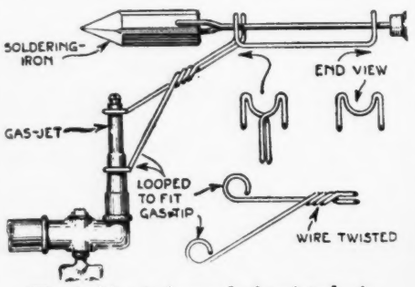
THE HOME WORKSHOP

Holder for Heating Soldering-Bit over Gas-Jet

FOR the occasional user of a soldering-bit, this holder is both simple and serviceable. The tip is held in the hottest part of the flame of a gas-jet by a twisted piece of



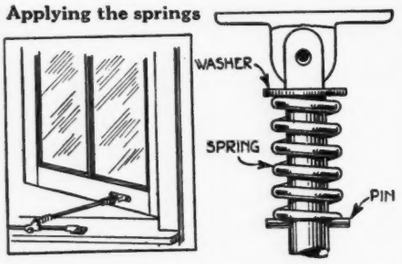
The holder is formed of twisted wire

stiff wire about 2 ft. long. It has two loop ends and is doubled into supporting arms to serve as a rest for the shank of the bit. The device may quickly be placed over the gas-jet when required and as quickly removed.—G. L.

To Stop Casements from Rattling

WHEN I purchased my home, the second-floor windows, which are of the casement type, rattled to an annoying extent. To prevent this, springs, washers

Applying the springs

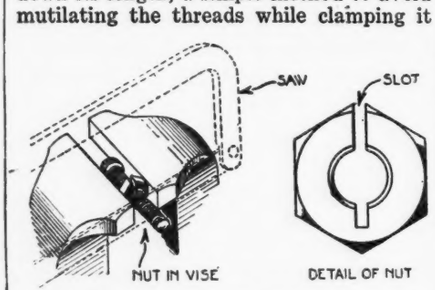


and pins were used on the sash adjusting rod in the manner illustrated so that all play between the parts was taken up and the windows could not rattle.

Simply drill the holes for the pins, remove the rivet from one end of the rod, assemble the parts, and re-rivet.—H. N. W.

Split Nut Holds Bolt in Vise

WHEN it is necessary to hold a nut in the vise while slotting it, drilling a cotter or wire hole through it, or cutting down its length, a simple method to avoid mutilating the threads while clamping it



The nut protects the threads

securely is to screw a partially split nut over the thread. It can then be clamped in the vise as solidly as desired without any damage being done to the threads. Studs, shafts, or other threaded parts can also be held by this means.—A. L. G.

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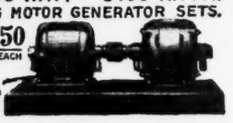

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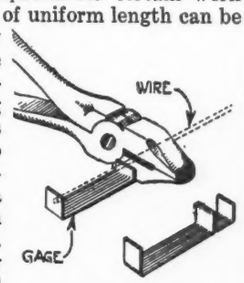
A Useful Gage for Cutting Short Lengths of Wire

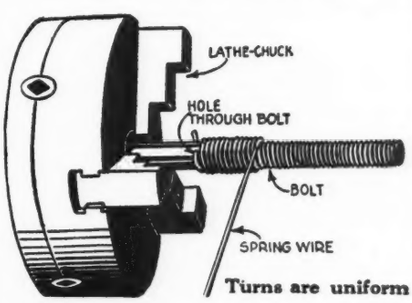
SOMETIMES a number of short lengths of wire are required for certain work where only pieces of uniform length can be used. It is not easy to make accurate measurements because the cutting edges of the pliers are beveled. To overcome this difficulty, provide a simple gage such as is shown here. It s made of any heavy sheet metal and the double end is bent so that the strip will hold firmly on the pliers.—D. C.



Gage for pliers

Winding Springs on a Screw

TO make springs with evenly spaced turns will be easy if the wire is wound on an old screw. The screw should be held and turned in a lathe-chuck.—J. B. MORAN.

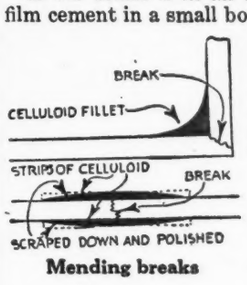


Turns are uniform

Repairing Celluloid Articles

ALMOST anything made of celluloid can be repaired, patched, built up, and otherwise worked with the aid of ordinary film cement such as is used in splicing motion-picture films. Where there are flat surfaces of sufficient area to give a good hold, the parts are simply cemented together after the surfaces are cleaned by scraping.

If the break is in an angle, put a little film cement in a small bottle and drop into it cut scraps of celluloid film. Old camera films are good for the purpose if all the emulsion has been washed off with hot water. The mixture should be of about the consistency of very soft putty.



Mending breaks

First cement the parts together in the ordinary way, so that they will hold temporarily. Then, with the celluloid mixture work a fillet or filling into the angle to act as a reenforcement, putting the putty on over a coating of cement. Although this dries rather slowly, it gets hard and makes a good job.

A flat piece can often be mended by cementing a thin strip of celluloid on each side. The edges of the strips can be worked down by scraping when the cement has set, so that the surface will be smooth, and can then be polished.—HOWARD GREENE.

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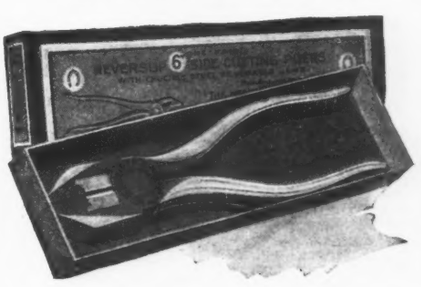

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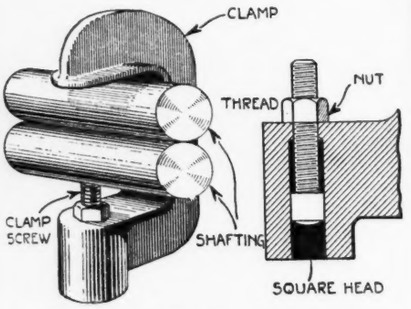
THE HOME WORKSHOP

Clamp with Setscrew and Nut Has Viselike Grip

SHAFTING that is difficult to grip with an ordinary C clamp, may be held as in a vise by a clamp similar to the one illustrated. The cross section shows the construction.

The movable member does not have any turning or swiveling movement, but is

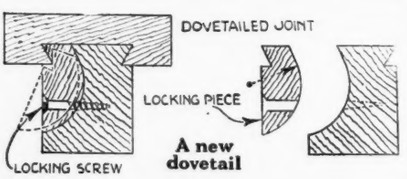


Only the casehardened nut turns

simply a cup-pointed setscrew capable of only longitudinal movement. Tightening the clamp is accomplished by turning a casehardened nut. A square hole nearly through the clamp body holds the square head so the screw never turns.—D. A. H.

A Novel Self-Locking Dovetail

THE home worker who enjoys experimenting with the more elaborate cabinetmaking joints will find much to interest him in this new joint, devised by a Frenchman. It is a dovetail tenon such as frequently is used in good furniture construction for top rails in order to prevent end-frames or members from spreading.



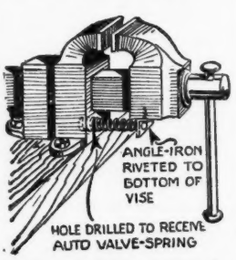
A new dovetail

Made in the manner illustrated, the joint can easily be assembled or disassembled through the use of the small locking-piece.

The obvious objection to it is that the thickness of the saw-kerf would be sufficient to spoil the accuracy of the joint, but that difficulty can be avoided if the curved cut is made before the dovetail and mortise are shaped. The hole for the screw should, of course, be drilled first of all and the locking-piece screwed temporarily in place before the dovetail is cut.—LOUIS DOUGLAS.

Preventing Lost Motion in Vise

WHEN using a vise at close range, any lost motion in the screw is objectionable. In order to prevent annoyance from this cause, an automobile valve-spring may be attached to the movable jaw by means of an angle-iron so that it presses against the stationary jaw.—H. B.



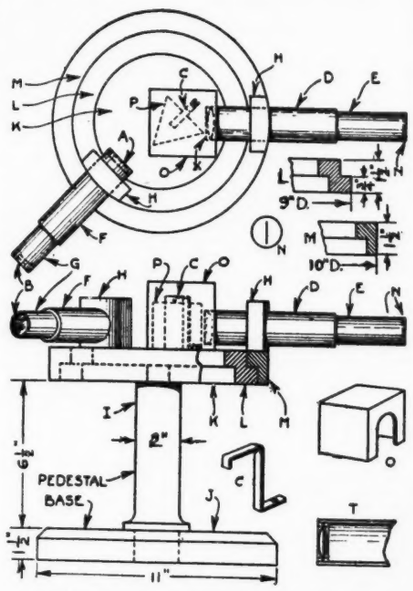
The spring attached

THE HOME WORKSHOP

Making a Spectroscope for the Home Laboratory

THE first step toward the construction of this spectroscope was having the standard members turned to the indicated dimensions. I then made up the two blocks *H*, which support the telescope and collimator tubes. Their size will vary according to the lenses used. After this framework was assembled, a coat of black enamel gave the whole a fine appearance.

The telescope was constructed from two lenses, *A* and *B*, taken from a pair of old



Top view, front view, and details

field-glasses, and two cardboard tubes, *F* and *G*. The detail sketch *T* shows the manner in which the lenses were mounted.

The collimator consists of a lens, *X*, of about 10-in. focus in a cardboard tube *D*, 8 in. long, another tube, *E*, 6 in. long, and a very thin brass disk *N*, with a slit in its center. This slit was made with the fine point of a knife. The method of mounting the lens and disk is the same as shown at *T*.

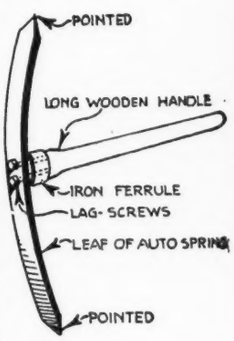
I purchased the prism that was mounted on *K* by a spring brass bracket *C*. The housing *O*, is a cardboard box that slips over the prism. The inside of the tubes *D*, *E*, *F*, and *G*, and the box *O*, were painted a dull black.—W. J. EDMONDS, JR.

Auto Spring-Leaf as Pickax

A PICKAX for breaking up soft soil can be made from one leaf of a discarded automobile spring.

Remove the leaf that appears to be the stiffest, and grind down each end to a point on an emery-wheel. Then drill two holes in the center. Bolt the leaf to the end of a stout handle with long, thin lag-screws.

The head end of the handle must be reenforced with a ferrule so that the screws will not split it.—L. R.



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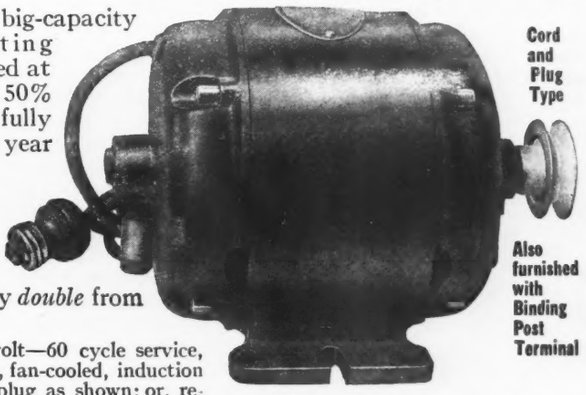

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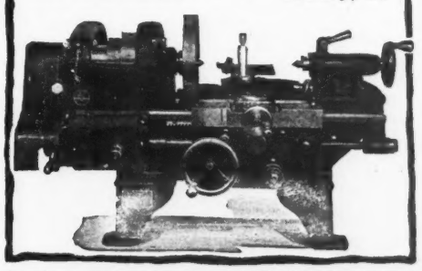

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Carpenter's Rule Serves as Square and Protractor

A CARPENTER'S ordinary 2-ft. rule can be made to serve as a square and bevel with sufficient accuracy for ordinary work by scribing a series of marks on the brass-rule joint. Use a steel square or a

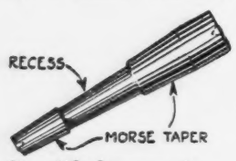
Laying out angles with a 2-ft. rule

draftsman's T-square and triangles to set the legs of the rule exactly at right angles to each other, and at 60, 45, and 30 degrees, and in each position draw marks as shown in the accompanying illustration.

I marked off a rule in this manner and have used it to advantage many times in my work.—JOHN DONOVAN.

Easy Method of Simplifying a No. 1 Morse Taper

HOW often have you required a taper-pin to fit either the headstock or tailstock spindle of your lathe? Possibly you have needed it to make a drill-pad or a friction chuck to hold some small part accurately.



Simplified taper pin

A taper-pin properly fitting your lathe is one of the most difficult things to make along orthodox lines. The accompanying sketch illustrates how the difficulty may be overcome. Set your slide-rest on the required angle and machine the stock nearly to size, then recess it as shown, and finish to a perfect fit with file and fine emery-cloth. You will find that it will hold as well if not better than a taper-pin proper.—WILLIAM J. BEACH.

Old Glass-Cutter Is Wrench for Small Nuts

A WRENCH for small nuts, such as are found on typewriters and other small machines and instruments, may quickly be

Making a glass-cutter into a wrench

made from an old glass-cutter. Cut off the point with a hacksaw as shown and, if necessary, file one of the square openings to fit the size of nut for which it is to be used.—R. L. JOHNSON.

Indoor Teeter Provides Fun for Kiddies

By J. Horace Van Nice

KEEPING little tots busy during a long spell of bad weather is a problem that is easily solved by providing a playground with interesting furnishings. A teeter such as shown in the picture will keep the youngsters satisfied and give them exercise at very little cost. An attractive feature of this teeter is that it can be quickly put together or dismantled, and therefore may be stored in the attic or a closet. If no regular playground is available, it may be set up in the kitchen or bedroom, because there is nothing about it likely to injure either floor or finish.

A plank 2 in. thick, 12 in. wide, and 6 ft. long makes a fine teeter-board if all the rough spots are smoothed and the edges rounded. The finish may be either painted in bright colors such as children like, or varnished over a coat of shellac. Strips of carpet are used as seat-pads.

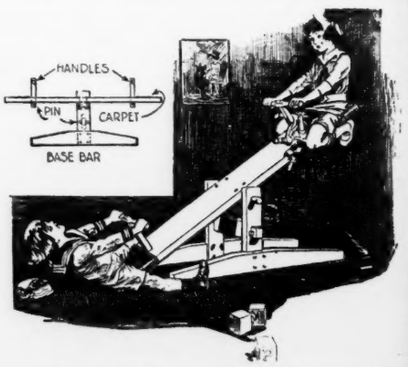
Each handle of the teeter is 1 in. square, 12 in. long, and rounded each side of the center. The handle posts are 2 in. square, 15 in. long. The upper end is rounded, and square 1-in. holes are chiseled to take the handles. The handles are inserted in the posts and secured with sixpenny casing-nails. The posts, in turn, have 1½-in. tenons at their lower ends to fit mortises in the plank. After the posts are fitted, drill ½-in. holes in the tenons as close to the under side of the plank as possible, and make pins that will fit tightly. It will be easy to slip out the pins, pull out the posts, and pack all away in a small space.

The teeter axle is made from a piece of 2 by 4 in., 24 in. long. For 5 in. at each end this is rounded and smoothed with fine sandpaper. It is bolted to the teeter-board at the center, with four 5-in. bolts, washers, and wing-nuts for quick dismantling.

Two uprights 2 in. thick, 6 in. wide, and 2 ft. high are required. The upper ends are rounded, as are all the edges. The 2-in. axle-bearing holes are 6 in. from the upper ends and drilled in the center of the uprights. They should be carefully smoothed out and painted with melted paraffin.

Four bolt-holes are drilled in the lower end of each upright as shown below. Square 2-in. holes for the body-brace tenons are chiseled 10 in. from the lower ends in the center of the uprights.

For the body brace use a piece 2 in. thick, 6 in. wide, and 2 ft. long. The ends



This teeter is quickly taken apart

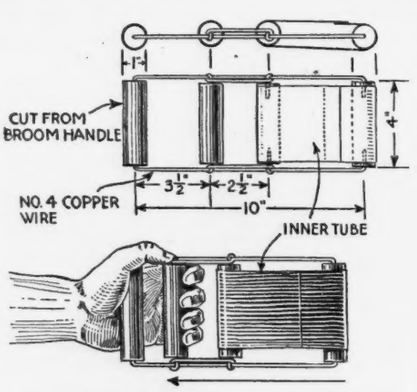
are cut 2 in. square for a distance of 4 in. to fit into the square holes in the uprights, and they are then drilled for pins just as in the case of the handle-posts. The two base bars are 2 in. by 6 in. pieces, 4 ft. long, tapered from points 6 in. from the center to the ends, where they should be three inches wide. Bolt-holes are drilled at the center to correspond with those in the lower ends of the uprights.

To put the teeter together, first put the handle-posts in the teeter-board, then fasten the axle to the teeter-board, taking care to put the nuts on the bottom side where the children will not be apt to catch against them. Slide the uprights over the ends of the teeter axle and body brace and pin the ends of the brace. Last of all, bolt on the base bars, fastening the wing-nuts inside as before.

The advantages of the teeter are its reliable strength, the quickness with which it may be assembled or dismantled, and the continual pleasure it gives the children.

This Exerciser Is Made from Leftovers

THE four rollers of this hand and forearm exerciser are cut from a broom handle. In the ends of three of them ⅜-in.



How the exerciser is made and used

holes are bored ¾ in. deep; in the other a similar hole is drilled all the way through.

The frame is made of a 27-in. length of No. 4 copper wire, bent as shown after one roller has been centered upon it. The ends are left straight until the other parts have been assembled.

A strip of rubber from a discarded inner tube, 3¾ in. by 12 or 13 in., is made into an elastic belt by lapping the ends 1 in. and cementing them together. When thoroughly dry, the belt is placed over one of the remaining rollers and two wires 5 in. long are looped in such a way that they will hold this roller and the other center roller in a fixed relation to each other, although free to slide on the guide wires. The ends of the frame are then bent to secure the fourth roller. As the hands and wrists become more muscular through using the exerciser, the elastic band may be shortened.—T. R. HART.

Reflected Light at the Bench

ADDITIONAL light on the vise may be obtained by placing a mirror on the wall back of the workbench in such a position as to reflect the light from a window. This will be particularly helpful in a cellar or other comparatively dark workshop whenever fine and accurate work has to be done on small parts.—C. W. T.